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WORK OF THE HUNTLEY FIELD STATION IN 1923 AND 1924 [1]

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The work of this station is intended to render assistance in solving some of the problems of local agriculture. Experiments are conducted in the production and utilization of crops of local importance on both irrigated and dry land. A view of the buildings on the farm is shown in Figure 1.

FIG. 1.—Buildings at the Huntley Field Station

[1] The Huntley Field Station is located on the Huntley Reclamation Project in the Yellowstone Valley of Montana. It occupies about 300 acres of public land, the larger part of which is irrigated, and is maintained cooperatively by the Office of Western Irrigation Agriculture and the Montana Agricultural Experiment Station. Other offices and divisions of the United States Department of Agriculture in the Bureaus of Plant Industry, Animal Industry, and Dairying cooperate in the investigational work.

CONDITIONS ON THE PROJECT

CLIMATIC CONDITIONS

The season of 1923, with unusually high rainfall, mean temperatures above normal, and a long frost-free period, was especially favorable for such crops as sugar beets and corn. Conditions in 1924 were somewhat reversed, and the season was more favorable for small grains.

The total rainfall in 1923 amounted to 18.06 inches, while the average for the 14-year period from 1911 to 1924, inclusive, during which weather observations were made at the Huntley Field Station, was 14.49 inches. Much of the rain in 1923 occurred during September and October and interfered rather seriously with harvesting sugar beets. The total rainfall in 1924 was 12.86 inches, and this was well distributed through the growing season.

The frost-free period of 148 days in 1923 extended from May 15 to October 11. The average frost-free period for the 14 years is 127 days. In 1924 the period free from frost was from May 26 to September 14, or a total of only 110 days.

TABLE 1.—*Summary of climatological observations at the Huntley Field Station during the period from 1911 to 1924, inclusive*

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
PRECIPITATION (INCHES)													
Average for 14 years, 1911 to 1924	0.66	0.37	0.82	1.17	2.29	2.57	1.46	0.83	1.48	1.19	0.81	0.83	14.49
For 1924	.53	.56	2.26	.87	1.55	2.48	1.59	.11	.27	.97	.53	1.14	12.86
EVAPORATION (INCHES)													
Average for 14 years, 1911 to 1924	------	------	------	3.330	4.732	6.130	7.455	6.823	4.417	------	------	------	32.887
For 1924	------	------	------	3.111	4.446	5.612	6.741	6.901	4.495	------	------	------	31.306
DAILY WIND VELOCITY (MILES PER HOUR)													
Highest:													
1911 to 1924	22.2	14.1	27.8	17.8	17.5	10.2	27.5	7.9	10.5	29.4	25.0	26.6	------
For 1924	10.3	9.8	5.8	8.5	7.8	7.3	6.1	7.9	3.9	9.4	9.8	11.6	------
Lowest:													
1911 to1924	.3	.5	.5	.6	.2	.4	.3	.3	.2	.5	.3	.1	------
For 1924	.5	.7	.7	1.4	.2	1.7	.3	1.1	.7	.7	.3	.1	------
Mean:													
1911 to 1924	5.2	4.6	4.7	5.2	4.8	3.7	3.2	3.2	3.5	3.8	4.0	4.8	------
For 1924	4.2	3.4	3.1	4.0	3.0	3.3	2.3	2.7	2.3	2.6	3.5	5.2	------
TEMPERATURE (°F.)													
Absolute maximum:													
1911 to 1924	64	70	74	87	99	107	105	103	95	91	75	67	------
For 1924	48	64	58	74	86	87	100	103	93	79	65	67	------
Absolute minimum:													
1911 to 1924	−39	−38	−37	4	22	32	38	33	24	−10	−28	−41	------
For 1924	−31	−13	3	20	26	40	42	33	28	25	−13	−39	------
Mean:													
1911 to 1924	20	23	34	47	58	69	76	74	61	49	35	22	------
For 1924	16	34	29	44	52	60	71	66	57	48	33	13	------

TABLE 1.—*Summary of climatological observations at the Huntley Field Station during the period from 1911 to 1924, inclusive*—Continued

KILLING FROSTS

Year	Last in spring		First in autumn		Frost-free period
	Date	Minimum temperature	Date	Minimum temperature	
		°F.		°F.	Days
1911	May 26	32	Sept. 18	28	114
1912	May 12	28	Sept. 15	31	125
1913	May 5	31	Sept. 19	29	136
1914	May 12	32	Oct. 6	31	146
1915	May 21	32	Sept. 19	32	120
1916	May 16	30	Sept. 13	31	119
1917	May 31	31	Sept. 28	32	119
1918	May 21	32	Oct. 7	28	138
1919	May 7	29	Sept. 27	32	142
1920	June 3	32	Sept. 24	32	112
1921	May 14	32	Sept. 9	32	117
1922	May 5	31	Sept. 28	29	145
1923	May 15	28	Oct. 11	30	148
1924	May 26	27	Sept. 14	32	110
Average	May 18	----------	Sept. 23	----------	127

Both seasons were free from any severe hailstorms, and injury to crops from this cause was generally slight. Hail occurring on August 15, 1924, resulted in some damage, mainly to sugar beets and corn, over a small area in the center of the project.

A summary of climatological observations for the period from 1911 to 1924, inclusive, is given in Table 1.

CROP CONDITIONS

In general, conditions affecting crop production were favorable in both 1923 and 1924. The unusually long growing season of 1923, with high average temperatures, was especially favorable for sugar beets and corn, and higher yields of beets were obtained than in any year during the 12-year period 1913 to 1924, inclusive. The comparatively short cool season of 1924 resulted in grain yields higher than in any year during the same period, while the yields of sugar beets were about the average.

The sugar-beet harvest in 1923 was delayed more than a month, and this work was made rather difficult because of heavy rains during September and October. In spite of interruptions, however, the harvest was completed before freezing weather set in, and the delay was no doubt largely responsible for the increased yield of beets.

Some damage resulted to crops in both years through a grasshopper invasion, although injury from this cause was less in 1924 than in 1923. The principal damage, especially in 1923, occurred to alfalfa and grain crops. Community action in control measures was taken each year. As a means of combating the grasshoppers the standard arsenic bran mash was used, the material for this purpose being supplied by Yellowstone County through a special tax levy.

The sugar-beet webworm also occurred on some parts of the project each season, although the damage caused by this pest was not serious.

In 1923 alfalfa hay was damaged to some extent by rains at the time of harvest, but in 1924 the quality of hay was excellent in all three crops.

CROPS ON THE HUNTLEY PROJECT

The crop census of the Bureau of Reclamation of the United States Department of the Interior reports the total cropped area of the Huntley project in 1923 to be 18,776 acres; in 1924 the area in crop on a total of 617 farms was increased by about 1,000 acres. The cropped acreage in 1924 was 62 per cent of the total irrigable area of the project. The lands not cropped include principally the heavy refractory soils on the lower part of the project.

The principal changes in crops were the increased acreage of beets and corn during both years and a corresponding decreased acreage of wheat. Lower prices for wheat during 1923 with increased prices for beets, together with the unusually high average yield of beets in 1923, resulted in stimulating interest in the latter crop.

Alfalfa in 1923 occupied 5,463 acres and in 1924 5,724 acres, or slightly more than one-fourth of the total cropped area. The average acre yield in 1923 was 2.09 tons and in 1924 2.35 tons.

The average acre yield of alfalfa for the 12-year period was 2.54 tons. This crop was used principally for the feeding of dairy cattle, sheep, and work stock, and in neither year was there any large quantity sold and shipped out. The market value per ton of alfalfa was given as $6.04 in 1923 and $7.90 in 1924.

In 1923 the area on the project cropped to beets was 4,630 acres. This was increased to 5,929 acres in 1924, which was the highest beet acreage in the history of the project. The average area in beets for the 12-year period was 3,754 acres. In 1923 and 1924 beets were paid for on a sliding scale basis, depending on the sugar content and selling price of sugar manufactured from the beets. The initial price of beets was $5.50 per ton in 1923 and $6 per ton in 1924, with additional payments from time to time throughout the year as the sugar was marketed. The total paid for the 1923 crop was $9 per ton.

The average yield of 13.43 tons per acre in 1923 was the highest yield in any year during the 12-year period from 1913 to 1924, inclusive, and was 3.5 tons higher than the average for this period. The high yield was probably due to a large extent to the exceptionally long and favorable growing season. The total production in 1923 was 62,213 tons, which was more than 3,000 tons greater than the total production in 1924, although the acreage in 1924 was increased by about 28 per cent. The average yield per acre in 1924 was 9.94 tons, which was about the average for the 12-year period. The acreage in 1924, which amounted to 30 per cent of the total cropped area of the project, would appear to be excessive for a system of well-balanced farming, and beets were grown in many cases on land not suited to this crop and on which low and unprofitable yields occurred.

Wheat in 1923 was grown on 3,075 acres, and the average yield was 19.3 bushels per acre, while in 1924 there was a decrease to 2,212 acres with an average yield of 24.13 bushels per acre. With seasonal conditions in 1924 especially favorable for this crop, the yield was higher than in any year during the 12-year period and 5.21 bushels higher than the average during this time. The selling price of $1.35 per bushel was higher than in any year since 1920.

The acreage cropped to oats has declined gradually each year, except in 1916, since the opening of the project. In 1923 there were 1,118 acres in this crop and in 1924 only 912 acres. The average acre yield of 37.47 bushels in 1924 was higher than in any year during the period for which crop reports are available and was about 10 bushels higher than the yield in 1923. This crop is used principally for feed for work stock, and the quantity grown is barely sufficient for this purpose. In the earlier years of the project it was used principally as a sod crop and as a nurse crop for alfalfa; consequently, as the land was developed and seeded to alfalfa, the acreage in oats became less.

TABLE 2.—*Acreage, yields, and farm values of crops produced on the Huntley Reclamation Project in 1923 and 1924*

Crop	Area (acres)	Unit of yield	Yield			Farm values		
			Total	Per acre		Per unit of yield	Total	Per acre
				Average	Maximum			
1923								
Alfalfa hay	5,463	Ton	11,428	2.09	5.0	$6.04	$69,098	$12.64
Alfalfa seed	52	Bushel	52	1	1.4	10.98	571	10.98
Barley	264	do	7,283	27.60	60.0	.53	3,850	14.58
Beans	120	do	945	7.87	18.0	2.52	2,390	19.81
Beets, mangel	6	Ton	91	15.16		3.41	311	51.83
Beets, sugar	4,630	do	62,213	13.43	21.6	9.00	559,917	120.93
Clover hay	70	do	79	1.12	4.5	5.69	449	6.37
Clover seed	126	Bushel	361	2.86	5.0	5.60	2,024	16.06
Corn	1,319	do	30,049	22.77	70.0	.62	18,604	14.10
Corn fodder	132	Ton	437	3.31	8.0	4.40	1,926	14.60
Garden	83						7,301	87.96
Hay other than alfalfa	201	Ton	186	.93	2.0	5.65	1,052	5.25
Oats	1,118	Bushel	30,552	27.32	70.0	.49	14,970	13.38
Onions	1	do	256	256	256.0	1.50	385	385.00
Pasture, summer	2,042						9,979	4.88
Pasture, winter [1]	15,082						36,220	2.40
Potatoes	68	Bushel	4,720	69.41	300.0	.69	3,260	47.90
Rye	6	do	60	10.00		.50	30	5.00
Wheat	3,075	do	59,265	19.27	42.5	.86	51,200	16.60
Total	18,776						783,537	
Average								41.74
1924								
Alfalfa hay	5,724	Ton	13,496	2.35	5.85	7.90	106,663	18.56
Alfalfa seed	46	Bushel	54	1.17	4.00	10.20	551	11.98
Barley	222	do	8,886	40.02	80.00	.65	5,760	26.21
Beans	540	do	4,942	9.15	25.00	2.70	13,342	24.70
Beets, mangel	1	Ton	10	10.00	10.00	7.50	75	75.00
Beets, sugar	5,929	do	58,858	9.94	17.00	9.00	529,722	89.46
Cane	3	do	6	2.00		5.00	30	10.00
Clover hay	65	do	170	2.63	3.50	5.51	938	14.43
Clover seed	228	Bushel	922	4.04	9.00	4.18	3,854	16.88
Corn	956	do	15,590	16.30	50.00	1.23	19,176	20.10
Corn fodder	398	Ton	1,044	2.62	10.00	3.98	4,158	10.43
Garden	149						8,120	54.50
Hay other than alfalfa	6	Ton	10	1.66		12.00	120	20.00
Millet seed	6	Bushel	12	2.00		2.00	24	4.00
Oats	912	do	34,154	37.47	85.00	.50	17,077	18.73
Onions	2	do	180	90.00	90.00	1.25	225	112.50
Pasture, summer	2,335	Acre					8,663	3.71
Pasture, winter [1]	12,609	do					27,192	2.15
Potatoes	21	Bushel	1,611	76.70	300.00	1.00	1,611	76.71
Rye	7	do	154	22.00		1.29	198	28.38
Sudan grass	6	do	60	10.00	10.00	3.00	180	30.00
Straw	4,084	Ton	7,253			.91	6,600	1.61
Wheat	2,212	Bushel	53,388	24.13	62.50	1.35	72,073	32.57
Total	19,768						826,352	
Average								41.80

[1] This consisted of alfalfa, beets, corn, wheat, and oats.

The acreage cropped to corn and fodder corn was about the same in 1923 as in 1924, amounting in each year to approximately 1,400 acres. The yield of 16.3 bushels per acre in 1924 was about 6 bushels less than in 1923. The season of 1924 was less favorable for corn than any season during the previous four or five years, and much of the crop was not fully matured at the time of the first killing frost, and the portion harvested as fodder corn was larger.

Other crops on the project in 1923 and 1924, of which there was not sufficient acreage to be considered of much importance, included beans, barley, and potatoes. The area in potatoes, which in 1923 was 68 acres and in 1924 but 21 acres, was not sufficient for local needs. Beans were grown for the first time to a significant extent in 1923, when there were 120 acres in this crop. In 1924 there was an increase to 540 acres. The average yields—7.87 bushels in 1923 and 9.15 bushels per acre in 1924—were rather low when compared with yields obtained in other irrigated sections, and this low yield is probably due in part to the fact that much of the crop was grown on the heavier soils of the project. This type of soil is apparently not suited to bean production.

The area cropped to barley was 264 acres in 1923 and 222 acres in 1924. The average yield of 40 bushels per acre in 1924 was about 12 bushels higher than in 1923 and nearly 20 bushels higher than the average for the 12-year period beginning in 1913.

The yields and farm values of crops grown in 1923 and 1924 are given in Table 2. Table 3 presents this data for the 12-year period from 1913 to 1924, inclusive. This information was furnished by the Bureau of Reclamation of the United States Department of the Interior.

TABLE 3.—*Summary of acreage, yields, and farm values of the principal crops grown on the Huntley Reclamation Project from 1913 to 1924, inclusive*

Item and year	All crops	Alfalfa hay	Barley	Sugar beets	Corn	Oats	Summer pasture	Winter pasture	Potatoes	Wheat
Acreage:										
1913	15,798	4,848	191	4,475	326	3,942			99	1,177
1914	17,068	6,038	363	4,274	497	3,226			120	1,663
1915	18,203	5,287	415	5,402	509	2,514	1,478		80	2,869
1916	18,581	5,422	298	5,264	174	2,628	1,393		54	2,624
1917	19,104	6,002	109	3,366	186	2,420	1,451		164	4,330
1918	19,265	6,776	75	1,963	203	2,006	1,091		73	6,306
1919	19,310	7,045	267	1,136	179	1,977	1,389	16,733	40	6,518
1920	20,021	7,468	324	2,330	392	1,764	2,074	15,550	78	5,098
1921	18,782	5,538	247	3,178	375	1,630	1,479	15,476	185	5,469
1922	19,523	6,167	223	3,106	425	1,434	1,670	11,181	149	5,793
1923	18,776	5,463	264	4,630	1,319	1,118	2,042	15,082	68	3,075
1924	19,768	5,724	222	5,929	956	912	2,335	12,609	21	2,212
Production:		*Tons*	*Bushels*	*Tons*	*Bushels*	*Bushels*			*Bushels*	*Bushels*
1913		16,725	2,535	45,511	5,418	113,766			11,889	21,410
1914		17,440	6,689	41,030	11,755	96,014			10,680	39,095
1915		15,010	8,196	53,911	9,258	75,319			9,360	56,863
1916		14,411	2,239	42,106	1,732	37,795			5,155	31,161
1917		14,062	1,304	28,553	3,497	70,470			21,272	83,450
1918		17,234	1,883	16,299	4,263	73,080			9,612	138,305
1919		18,713	5,354	12,015	5,046	58,707			4,781	103,149
1920		16,962	4,816	14,814	4,441	40,960			6,449	83,549
1921		9,564	5,906	31,924	7,307	35,191			18,500	93,684
1922		14,102	6,571	34,901	9,164	47,068			20,218	115,416
1923		11,428	7,283	62,213	30,049	30,552			4,720	59,265
1924		13,496	8,886	58,858	15,590	34,154			1,611	53,388

TABLE 3.—*Summary of acreage, yields, and farm values of the principal crops grown on the Huntley Reclamation Project from 1913 to 1924, inclusive*—Con.

Item and year	All crops	Alfalfa hay	Barley	Sugar beets	Corn	Oats	Summer pasture	Winter pasture	Potatoes	Wheat
Average acre yield:		*Tons*	*Bushels*	*Tons*	*Bushels*	*Bushels*			*Bushels*	*Bushels*
1913		3.45	13.27	10.17	16.62	28.86			120.10	18.19
1914		2.90	18.40	9.60	23.65	29.80			89.00	23.50
1915		2.82	19.75	9.98	18.19	29.96			117.00	19.82
1916		2.66	7.50	8.00	9.97	14.38			95.20	11.87
1917		2.34	12.00	8.48	18.78	29.11			129.71	19.25
1918		2.55	25.11	8.30	21.00	36.43			131.70	21.93
1919		2.65	20.05	10.58	28.19	29.69			119.50	15.82
1920		2.27	14 82	6.36	11.33	23.22			82.68	16.38
1921		1.73	23.91	10.04	19.51	21.58			100.00	17.12
1922		2.50	29.46	11.23	21.57	32.82			135.63	19.92
1923		2.29	27.60	13.43	22.77	27.32			69.41	19.29
1924		2.35	40.02	9.94	16.30	37.47			76.70	24.13
FARM VALUES										
Per unit of yield:	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
1913		5.50	0.48	6.00	1.05	0.32			0.45	0.66
1914		5.00	.53	6.00	.62	.32			.62	.98
1915		5.76	.53	5.92	.80	.49			.72	.87
1916		8.95	.92	6.08	.86	.63			1.14	1.46
1917		14.70	1.20	7.27	1.46	.78			.77	1.88
1918		11.99	.98	10.00	1.25	.79			.69	1.94
1919		19.66	1.68	10.00	1.53	1.16			1.77	2.37
1920		7.90	.89	12.00	.81	.67			1.11	1.44
1921		7.97	.46	6.78	.68	.40			.81	1.01
1922		8.48	.48	8.00	.74	.57			.49	.88
1923		6.04	.53	9.00	.62	.49			.69	.86
1924		7.90	.65	9.00	1.23	.50			1.00	1.35
Per acre:										
1913	29.35	18.97	6.37	61.02	17.45	9.24			54.04	12.00
1914	26.63	14.45	9.75	57.60	14.65	9.54			55.18	23.03
1915	29.41	16.20	10.47	59.08	14.55	14.68	3.76		84.24	17.24
1916	26.32	23.84	6.93	48.61	8.62	9.00	6.36		108.53	17.35
1917	36.16	34.46	14.42	61.66	27.39	22.69	6.36		99.87	36.22
1918	39.00	30.57	24.71	83.00	26.50	28.86	9.70		90.87	42.60
1919	49.14	52.22	33.69	105.77	43.11	34.40	11.94	3.94	211.55	37.51
1920	27.11	17.94	13.23	76.29	9.18	15.55	8.74	1.82	91.77	23.54
1921	25.23	13.78	10.96	68.07	13.31	8.51	5.40	1.52	81.43	17.29
1922	31.12	19.39	14.11	89.89	15.94	18.76	6.84	1.66	66.45	17.32
1923	41.74	12.64	14.58	120.93	14.26	13.38	4.88	2.40	47.90	16.60
1924	41.80	18.56	26.00	89.46	20.10	18.73	3.71	2.15	76.71	32.57
Total:										
1913	463,697	91,987	1,216	273,066	5,688	36,405			5,350	14,130
1914	454,583	87,200	3,545	246,180	7,288	30,724			6,622	38,313
1915	535,363	86,458	4,344	319,153	7,406	36,906	5,557		6,739	49,471
1916	489,071	129,263	2,068	255,826	1,496	23,651	8,867		5,889	45,529
1917	690,760	206,838	1,568	207,562	5,101	54,915	9,237		16,301	156,838
1918	750,964	206,712	1,854	162,990	5,381	57,899	10,588		6,616	268,616
1919	948,968	367,898	8,995	120,150	7,720	68,000	16,580	65,834	8,462	244,464
1920	543,781	134,000	4,289	177,769	3,597	27,443	18,136	28,301	7,158	120,041
1921	473,860	76,234	2,707	216,445	4,991	13,873	7,981	23,483	15,065	94,521
1922	607,597	119,620	3,147	279,208	6,775	26,900	11,442	18,594	9,992	100,319
1923	783,537	69,098	3,850	559,917	18,604	14,970	9,979	36,220	3,260	51,200
1924	826,352	106,663	5,760	529,722	19,176	17,077	8,663	27,192	1,611	72,073

LIVESTOCK

The annual livestock census of the Huntley project indicates that in 1923 there was a decrease in the number of all classes of livestock except sheep kept on farms, but that in 1924 the numbers of most kinds of stock increased again to near the average and in some cases higher than in previous years. The principal increase was in the number of cattle of both beef and dairy breeds and in the number of sheep brought in for winter feeding.

In 1923 there were but 1,534 dairy cattle; in 1924, the number reported was 2,250, an increase of nearly 50 per cent. The numbers given include dairy stock of all ages, and of the total in 1924 there were 1,345 cows in production. The total quantity of butterfat

produced was 257,605 pounds. The average price paid during the year was about 37 cents per pound, so that the total value of butterfat produced was $95,313.85. For the most part, herds are small and have usually not more than five to eight cows, so that dairying is not the major part of the farming operation.

In connection with the dairy work of the field station, purebred bulls from the station herd of Holstein cattle are lent to local farmers. This is part of an experiment in producing proved sires, but it is of direct benefit to farmers, and herds in which such animals have been used are already in many cases showing improvement in production, although this work has been under way only since 1919. Of a total of 32 bulls that are in use in the Yellowstone and Big Horn Valleys 11 are on the Huntley project in 29 herds, with a total of 383 cows. Farmers using these bulls are required to keep production records of their cows and to have their cattle tested and free from disease.

In 1924 there were 1,801 beef cattle on project farms, an increase of more than 1,000 over the previous year. The cattle were brought in from adjacent ranges for a winter feeding period of four or five months.

The winter feeding of sheep, principally lambs, although not yet so extensive as it might profitably be made, gained in both years, and in 1924 there were more than 3,600 sheep brought in for this purpose.

These sheep are fed principally on sugar-beet tops, alfalfa hay, wet beet pulp, and in some cases a light grain ration. This feeding is usually done under a contract in which the company furnishing the feeders agrees to take the finished lambs at an increase in price per pound. After about a 60-day feeding period in 1924 the spread in price was 1½ cents per pound, and the price at which the lambs were turned off was 11½ to 12 cents per pound. Weather conditions were very favorable for this enterprise in 1924, and most feeders realized a substantial profit from their operations.

A few small farm flocks of sheep are kept the year round, and the total number of sheep in these flocks in 1924 was about 400. With the prices obtaining for wool and mutton during this time farmers who have kept small flocks have received good returns, and this would appear to be another method by which local farmers can increase their income.

Hog raising on the project declined to the lowest point in 1923, in which year the total number raised was 1,190. In 1924 there were 1,600 hogs produced. Of this number, 269 were reported as held as breeding stock at the end of the year. The lack of interest in the hog industry is due to a large extent to the high cost of feed and the long distance from market, and the production of pork is not much more than sufficient to supply local demands for fresh meat.

In 1923 there were 20,214 fowls on project farms and a slightly greater number in 1924. These were kept in small flocks of seldom more than 100 hens. The total production of eggs in 1924 was 137,523 dozen.

The total number and average value of each class of livestock on the Huntley project each year for the period from 1914 to 1924, inclusive, are given in Table 4.

TABLE 4.—*Number and value of livestock on farms on the Huntley Reclamation Project during the period from 1914 to 1924, inclusive*

Livestock	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
Number:											
Horses	2,008	1,961	1,961	2,145	2,120	2,297	2,041	1,865	1,875	1,547	2,158
Mules	53	53	58	80	51	46	34	58	61	33	60
Cattle—											
Beef	2,921	3,316	1,982	1,795	1,813	2,631	1,312	1,765	1,395	751	1,801
Dairy			1,753	1,949	1,920	2,040	1,804	1,542	1,951	1,534	2,250
Sheep	847	6,198	3,729	1,974	1,130	2,115	2,352	1,486	1,310	2,384	3,998
Hogs	4,612	4,866	2,791	2,363	2,391	3,097	1,885	1,365	1,622	1,190	1,600
Fowls	23,345	18,758	16,418	16,920	15,856	21,456	18,232	18,500	23,036	20,214	21,644
Bees, hives	249	288	282	296	424	458	180	442	210	193	187
Average value:											
Horses	$108.88	$117.37	$124.00	$131.73	$108.70	$110.00	$88.90	$64.53	$52.26	$46.71	$44.04
Mules	134.90	135.09	138.00	134.56	107.16	81.50	94.40	82.44	53.97	67.42	48.92
Cattle—											
Beef	47.45	47.05	42.00	47.51	51.03	47.70	42.90	26.00	25.66	25.19	26.21
Dairy			64.00	54.02	60.18	62.30	63.45	43.39	40.62	43.34	31.85
Sheep	3.22	4.71	5.80	8.13	13.41	8.40	6.19	4.00	7.43	7.38	10.66
Hogs	9.68	5.51	8.00	15.40	18.07	13.64	11.15	8.00	10.29	9.69	7.81
Fowls	.49	.50	.54	.61	.52	.66	.69	.56	.63	.55	.53
Bees, hives	3.07	5.09	3.33	3.17	3.78	5.35	7.30	6.12	8.00	5.95	5.51

EXPERIMENTS WITH IRRIGATED CROPS

ROTATION EXPERIMENTS [2]

An extensive series of irrigated-crop rotation experiments was begun in 1912. This work was located on 70 quarter-acre plats in field K. In 1916 these experiments were extended by the addition of 27 quarter-acre plats in field L–IV. Seven of the principal crops of local importance are included in these investigations. These crops are grown in a number of combinations in eleven 2-year, five 3-year, four 4-year, and six 6-year rotations. In addition, 14 plats are devoted to the continuous cropping of these crops for purposes of comparison. The arrangement of the fields and the location of the experiments are shown in Figures 2 and 3.

It has been the object of these experiments to determine (1) the effect of crop sequences, (2) the value of alfalfa in a rotation, (3) the effect of manure in a rotation, and (4) to compare the rotation of crops with continuous cropping.

Crop-rotation experiments require many years of results before definite conclusions may be drawn. Although further work may not lead to great variations in results, it should at least clarify certain points which appear problematical at this time and furnish a more reliable basis for the formation of accurate conclusions. However, the results that are now available are thought to point out what is to be expected through longer experimentation and to give some indication of the effect of the various crop sequences and the value of alfalfa and manure in a rotation.

A wide variation has occurred each year between the highest and lowest yields of each crop. The maximum yields are usually obtained from some rotation which includes alfalfa or manure. Minimum yields generally occur in the shorter rotations or continuously cropped plats.

[2] This report was prepared by David A. Savage, junior agronomist, who had charge of the rotation experiments.

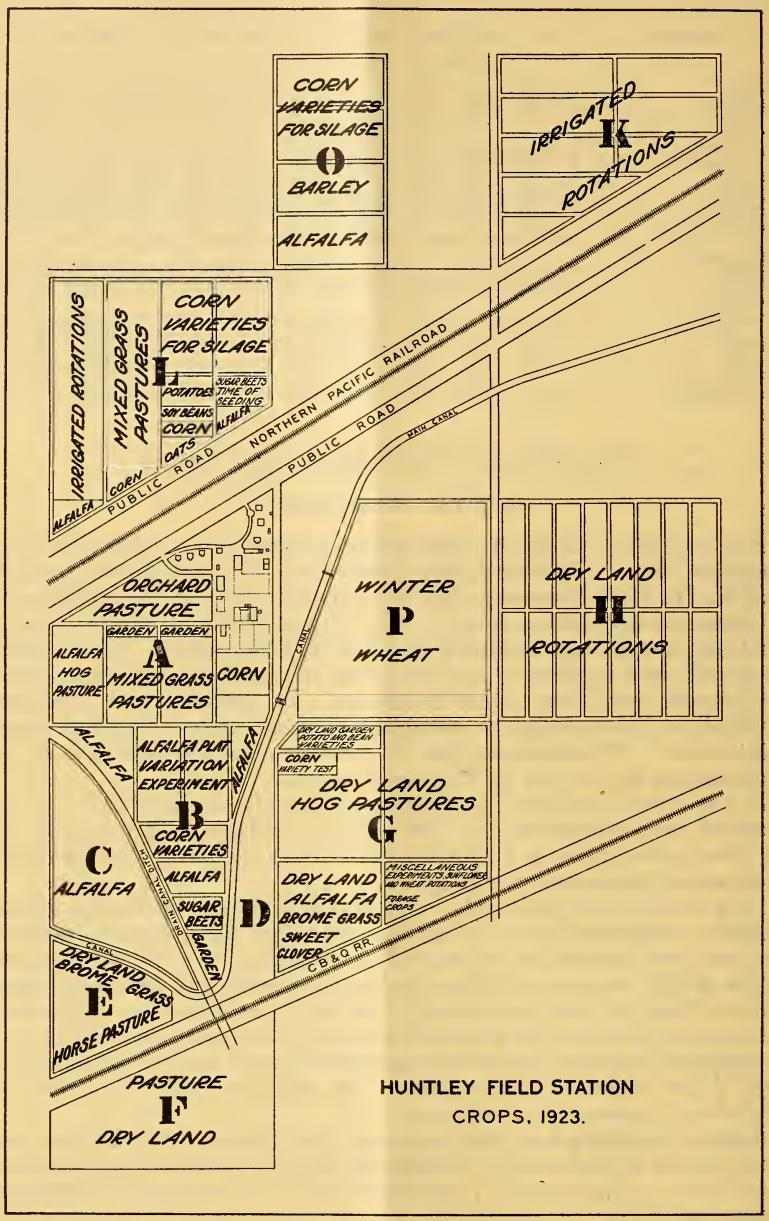

FIG. 2.—Diagram showing the arrangement of the fields and the location of the experiments at the Huntley Field Station in 1923

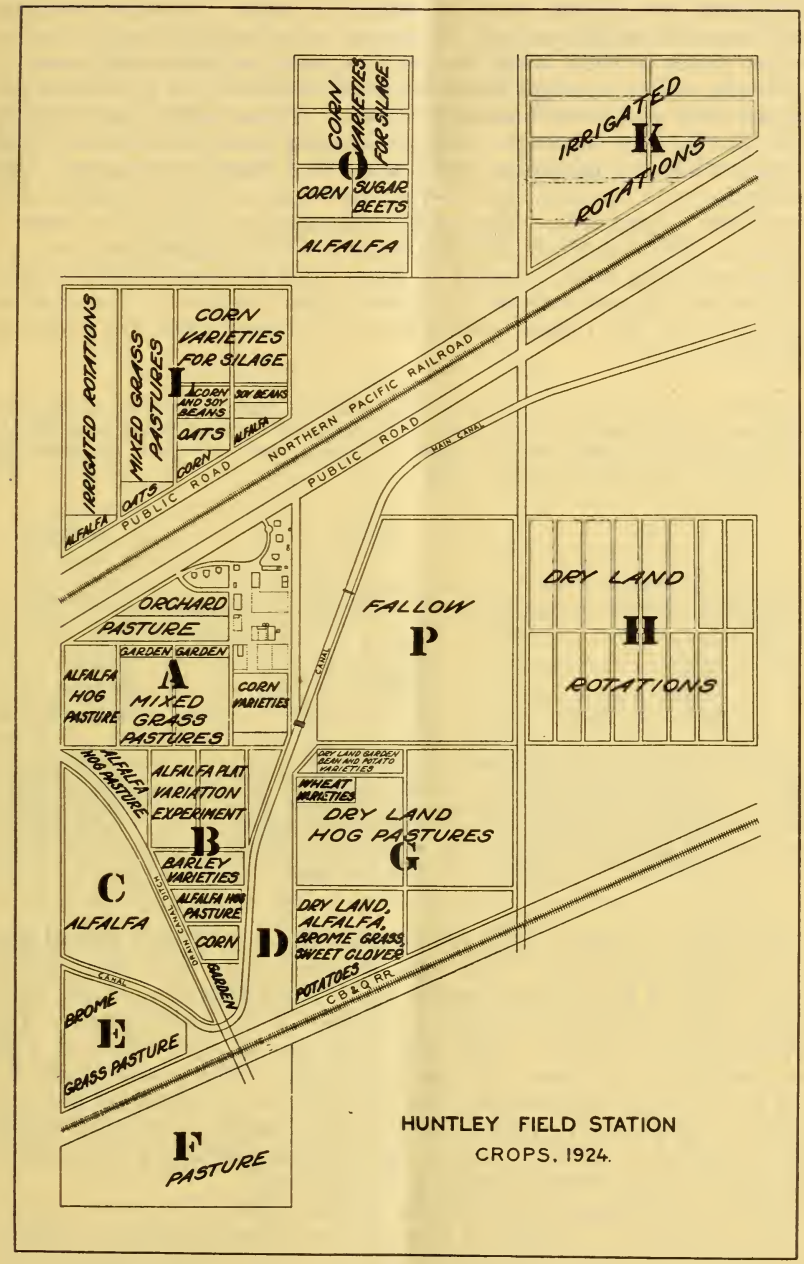

FIG. 3.—Diagram showing the arrangement of the fields and the location of the experiments at the Huntley Field Station in 1924

Alfalfa.—The yields of alfalfa were lower in 1923 than in previous years, while the highest yields that have been recorded since the experiment was begun were obtained in 1924. Adverse weather conditions during the periods of harvest were largely responsible for the low yields in 1923, while the reverse was true of the 1924 crop.

Potatoes.—The average yields of potatoes were 211.7 bushels per acre for 1923 and 209.2 bushels for 1924. These yields were slightly below the 12-year average. The maximum yield for 1923 was 342 bushels, while the minimum yield was 124.3 bushels per acre. The maximum yield occurred in a 3-year rotation in which potatoes followed oats (manured). The yields obtained in 1924 ranged from a minimum of 65.3 bushels to a maximum of 376 bushels per acre.

The preceding crop, number of plats, and average yields of oats, potatoes, and sugar beets for the period from 1913 to 1924, inclusive, together with the results obtained in 1923 and 1924 are given in Table 5.

TABLE 5.—*Average per acre yields of oats, potatoes, and sugar beets in irrigated rotations at the Huntley Field Station experiments for the 12 years from 1913 to 1924, inclusive, together with the number of plats used each year, the preceding crop, and the yields in 1923 and 1924*

Oats					Potatoes					Sugar beets				
Preceding crop	Number of plats	Yields (bushels)			Preceding crop	Number of plats	Yields (bushels)			Preceding crop	Number of plats	Yields (tons)		
		Average, 12 years	1924	1923			Average, 12 years	1924	1923			Average, 12 years	1924	1923
Corn (hogged)	1	93.0	105.0	85.0	Oats (manured)	2	311.2	323.7	322.8	Flax	1	15.24	16.13	25.42
Beets	6	89.0	88.7	91.3	Alfalfa	5	266.2	247.5	237.0	Potatoes	6	13.53	16.63	21.94
Alfalfa	1	89.0	96.2	94.5	Oats	2	236.2	233.7	184.0	Oats (manured)	3	13.18	16.39	19.06
Potatoes	8	81.7	104.9	87.4	Beets (manured)	1	234.9	230.7	179.7	Alfalfa	1	11.10	9.34	17.40
Corn	2	64.3	68.8	69.1	Beets	3	202.3	158.0	192.5	Oats	5	10.22	12.02	16.61
Wheat	1	51.9	53.7	59.5	Corn	1	197.2	129.8	148.7	Beets	2	9.57	8.04	14.17
Oats	2	48.7	49.4	42.6	Potatoes	2	183.2	152.0	185.6	Wheat	1	8.37	6.68	13.38
					Oats (rye)	1	92.6	65.3	124.3					

The highest average yield of potatoes for the 12-year period was 311.2 bushels per acre. This was obtained from two rotations in which potatoes follow oats (manured). The yields of potatoes after alfalfa, oats, and beets (manured) ranked in the order given. The corresponding yields for 1923 and 1924 are in direct accord with those for the entire period of the experiment. The lowest yields for 1923 and 1924, as well as the minimum yield of 92.6 bushels per acre for the 12-year period, occurred in a 2-year rotation in which potatoes follow oats (rye). The rye in this case is fall seeded and plowed under as a green manure before planting the potatoes.

The effect of manure and alfalfa on the yields of potatoes is presented in Table 6. Yields of potatoes from four rotations containing manure and three containing alfalfa are in turn compared with the yields from an equal number of rotations which are the same in all respects except that no manure or alfalfa is used. The 1923, 1924, and 11-year average yield for each group of rotations is given. A very substantial increase in yield of potatoes in both manured and

alfalfa rotations is noted, with the margin of increase in favor of alfalfa. The increase in yield due to manuring was 34.1 bushels per acre, while that in favor of alfalfa was 43.5 bushels for the 11-year period. In 1923 an increase of 63.9 bushels of potatoes per acre in favor of the manured rotations was obtained, as compared with an increase of 51.5 bushels in favor of the alfalfa rotations above the potato yields from rotations containing neither alfalfa nor manure. The great difference in favor of manure as compared with alfalfa in this particular instance is probably due to seasonal variation.

TABLE 6.—*Effect of alfalfa and manure on the yield of potatoes in the irrigated rotations at the Huntley Field Station in 1923 and 1924*

Year	Average acre yield							
	Check, 4 plats	Manured, 4 plats	Check, 3 plats	Alfalfa land, 3 plats	Increase in favor of—			
					Manure		Alfalfa	
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*P. ct.*	*Bush.*	*P. ct.*
1923	190.2	254.1	165.8	217.3	63.9	33.5	51.5	31.0
1924	185.0	247.7	166.0	226.4	62.7	33.8	60.4	36.3
11-year average	226.5	260.6	205.5	249.0	34.1	15.0	43.5	21.1

It should not be assumed from these results, however, that alfalfa invariably exerts an influence upon potato yields greater than that of manure. The sequence arrangement within most of the rotations here compared is of such a nature that alfalfa has a marked advantage over manure when considered with reference to potatoes. In the rotations with alfalfa, potatoes are grown directly following the alfalfa in every case, but they occur immediately following manure in but two of the manured rotations. In these two rotations the crop alternates in turn with oats and beets. One 3-year rotation consisting of oats (manured), beets, and potatoes is compared with another containing the same three crops without manure. Here the effect of manure will necessarily be less apparent, the application having been made two years preceding the crop. In a 6-year rotation containing oats (manured), beets, three years of alfalfa, and potatoes, the potato crop is still farther removed from the manurial application. In a comparison of this rotation with another 6-year rotation containing the same crops without manure the effect of the manure appears to be greatly diminished, owing to the equalizing influence of the alfalfa in both rotations.

A 7-year average of one pair of rotations in field L–IV shows an increase of 43.2 bushels per acre due to manuring. These are 3-year rotations, one of which consists of oats, potatoes, and beets, while the other represents the same crop combination with the addition of manure to the oat stubble directly preceding the potatoes. Another rotation, comprising the same three crops and in addition three years of alfalfa, is compared with the check rotation having neither manure nor alfalfa and shows an average increase of 16.8 bushels of potatoes in favor of alfalfa. Here, again, the potatoes directly follow alfalfa.

A more direct comparison between the effect of manure and alfalfa upon potato yields is possible from these three rotations than from

those previously cited, although the number of rotations is less and the data cover a shorter period of time.

Sugar beets.—Owing to favorable seasonal conditions the yields of sugar beets were higher in 1923 than in any previous year. In 1924 the yields were also greater than the average of the 12-year period, although less than in 1923. The maximum yields obtained in 1923 and 1924 were 26.15 and 19.91 tons per acre, respectively. The highest yield in 1923 occurred in a 6-year rotation containing alfalfa and manure, and in 1924 the highest yield was in a 2-year rotation where sugar beets follow potatoes and manure is applied to the potatoes. In 1923 the minimum yield of 12.09 tons per acre occurred in a 2-year rotation of oats and beets. The minimum yield of 6.36 tons per acre in 1924 was obtained from a continuously cropped plat. (Figs. 4 and 5.)

FIG. 4.—Sugar beets in a 6-year rotation consisting of three years of alfalfa followed by corn, small grain, and beets, in which the third-year crop of alfalfa and the corn are hogged off. The acre yield of beets in 1923 was 26.15 tons. The 13-year average acre yield of beets in this rotation was 13.93 tons

As shown in Table 5, the highest average yield of sugar beets, 15.24 tons per acre, for the period from 1913 to 1924, inclusive, was obtained in a 6-year rotation where the beets were directly preceded by flax. In this rotation flax follows corn and alfalfa, both of which crops are pastured by hogs, and the residual effect of the manure and alfalfa is probably responsible in a large measure for the high yield of beets. The highest yield of beets in 1923 was also obtained following flax, and in 1924 following potatoes. The minimum average yield of 8.37 tons per acre for the 12-year period and the minimum yields for 1923 and 1924 were obtained in a 2-year rotation where beets follow wheat.

The influence of alfalfa and the effect of manure on the yields of sugar beets in the irrigated rotations for the years 1923, 1924, and for an 11-year average are shown in Table 7. The four rotations which are used as a check in comparison with an equal number of manured rotations are the same as the latter in every respect except that no manure is used. Likewise, only those rotations which are directly comparable with regard to alfalfa are used in arriving at the relative effect of this crop.

From the results here presented, the favorable influence of both manure and alfalfa is apparent. The average increase caused by manure was 3.29 tons per acre, or at the rate of 31.5 per cent for the

FIG. 5.—Sugar beets in rotation No. 30, consisting of potatoes, oats, and beets without manure. The acre yield of beets in 1923 was 12.42 tons and the 13-year average acre yield 8.04 tons

11-year period from 1914 to 1924, inclusive; that caused by alfalfa was 2.23 tons per acre, or 21.5 per cent, during the same interval. These figures are sufficiently large to emphasize the importance of using manure and alfalfa in a rotation with sugar beets.

TABLE 7.—*Effect of alfalfa and manure on the yield of sugar beets in the irrigated rotations at the Huntley Field Station in 1923 and 1924*

Year	Average acre yield							
	Check, 4 plats for manure	Manured, 4 plats	Check, 4 plats for alfalfa	Alfalfa land, 4 plats	Increase in favor of—			
					Manure		Alfalfa	
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Per cent*	*Tons*	*Per cent*
1923	16.21	22.16	16.88	21.29	5.95	36.7	4.41	26.1
1924	12.75	17.27	12.75	16.06	4.52	35.4	3.31	26.0
11-year average	10.44	13.73	10.38	12.61	3.29	31.5	2.23	21.5

Here, unlike the results obtained with potatoes and oats, manure appears to exert an influence upon beet yields greater than that of alfalfa. The crop sequence, however, is at least partially responsible for this difference. In all the manured rotations except one 2-year rotation, sugar beets are grown immediately following the manure, thereby receiving the direct benefit of such applications. Typical examples of these rotations are a 2-year cropping plan of oats (manured) and beets and a 3-year rotation of oats (manured), beets, and potatoes. On the other hand, in the alfalfa rotations under consideration, the sugar beets are as far removed from the alfalfa as the length of the rotation will permit. Examples of these rotations are two years of alfalfa, oats, and beets in a 4-year rotation and three years of alfalfa, potatoes, oats, and beets in a 6-year rotation. Hence, no very direct comparison can be made between the relative effect of manure and alfalfa according to the above table, although each may be studied separately to very good advantage.

In field L–IV are three rotations from which the effect of manure and alfalfa may be more directly compared and for which seven years' results are available. A single check rotation consisting of oats, potatoes, and beets is used in each case. This 3-year rotation is compared with another containing oats (manured), potatoes, and beets and, in turn, with a 6-year rotation consisting of oats, three years of alfalfa, potatoes, and beets in order to ascertain the effect of manure and of alfalfa, respectively. The increase as a result of manuring was 2.26 tons per acre, while that caused by alfalfa was but 1.01 tons per acre, showing the advantage to be in favor of manure. Although these figures represent only three rotations and cover a period of only seven years, they are of particular value in that the manure in the 3-year rotation holds the same place with reference to beets as does alfalfa in the 6-year rotation, thus overcoming the difference in crop sequence apparent above and further emphasizing the value of manure for beets.

Oats.—Oat yields in 1923 were slightly above the average. In 1924 the average yield of oats was higher than in any previous year with the exception of 1918. The maximum yield of 101.6 bushels per acre in 1923 occurred in a 2-year rotation receiving manure, and that of 120 bushels in 1924 in a 6-year rotation including alfalfa. The minimum yields of 41.9 bushels for 1923 and 47.5 bushels for 1924 occurred in the continuously cropped plats.

The results for the 12-year period, as presented in Table 5, indicate that oats gave the highest returns in a rotation in which they followed corn pastured by hogs. The average yield of oats in this rotation was 93 bushels per acre. The average yield of the six plats of oats following beets and of one plat following alfalfa was 89 bushels per acre in each case. Oats following potatoes or corn gave a much better yield than when following a small-grain crop. The lowest average yield of 48.7 bushels per acre for the 12-year period was obtained from the two continuously cropped plats.

The effect of manure and alfalfa on the yields of oats in the irrigated rotations is shown in Table 8. An average of the results obtained from three pairs of rotations in each case form the basis for the comparison. The 1923, 1924, and average yields from 1914 to 1924, inclusive, are given. The yields as presented for the check plats represent results obtained from rotations which are identical

in every respect with those with which they are compared, except that manure or alfalfa, as the case may be, is omitted.

TABLE 8.—*Effect of alfalfa and manure on the yield of oats in the irrigated rotations at the Huntley Field Station in 1923 and 1924*

Year	Average acre yield							
	Check, 3 plats	Manured, 3 plats	Check, 3 plats	Alfalfa land, 3 plats	Increase in favor of—			
					Manure		Alfalfa	
	Bush.	*Bush.*	*Bush.*	*Bush.*	*Bush.*	*P. ct.*	*Bush.*	*P. ct.*
1923	83.6	88.3	83.6	96.7	4.7	5.6	13.1	15.6
1924	87.5	109.5	87.5	110.0	22.0	25.1	22.5	25.7
11-year average	76.6	81.0	76.6	88.8	4.4	5.7	12.2	15.9

According to the results for the 11-year period, alfalfa appears to exert an influence upon oat yields greater than that of manure. The average increase in favor of alfalfa was 12.2 bushels per acre or 15.9 per cent, as compared with an increase of 4.4 bushels, or 5.7 per cent, effected by manuring. This disparity in yields is due mainly to a difference in crop sequence between manured and alfalfa rotations. The manure is applied from two to three years in advance of actually growing the oats. A more marked response might have been noted were the application made more directly preceding the crop.

In the alfalfa rotations, for which 11 years' results are available, oats are grown either directly following alfalfa or the second year after that crop, thus accounting for the difference in yields in favor of alfalfa as compared with manure.

A limited number of rotations were begun in 1916 from which a more direct study of the relative effect of manure and alfalfa may be made. A single rotation containing manure and another containing alfalfa are in turn compared with a check rotation which consists of the same crops and sequence without either manure or alfalfa. Oats are grown three years following alfalfa and as many years following the manurial applications, thus overcoming the difference in sequence noted above. The residual effect of manure resulted in an increase of 4.8 bushels per acre, whereas that of alfalfa caused an increase of 2.8 bushels. Had a more favorable crop sequence been used the increase in each case might have been greater. It is interesting to note that with uniform crop sequence, manure produces a greater increase in yields than does alfalfa. These results, however, should not be given undue credence, as they represent a short period of years and a limited number of rotations. It may be that alfalfa exerts a pronounced immediate effect but soon loses its residual influence.

Wheat.—The average yield of wheat in 1923 was 20.4 bushels and in 1924 18.8 bushels per acre. The average yields are the lowest that have been recorded over the 12-year period. Wheat is grown in only two 2-year rotations and on three continuously cropped plats.

Corn.—In 1923 the maximum yield of corn was 61.4 bushels, the minimum 28.6 bushels, and the average 53.3 bushels per acre. A

still greater range in yields was obtained in 1924, the maximum being 67.3 bushels and the minimum 19.4 bushels per acre. The average yield for 1924 was 46.7 bushels per acre, as compared with an average of 45.2 bushels for the 12-year period.

Flax.—The two flax plats averaged 16.6 bushels per acre in 1923 and 17.3 bushels in 1924. These yields are slightly above the average of 16.5 bushels per acre for the series of years from 1913 to 1924, inclusive.

EXPERIMENTS WITH CORN

Though corn has been a crop of only minor importance on the project, it has increased to some extent in recent years. With the development and selection of early-maturing varieties it would appear that this crop might be grown to advantage in a limited way, especially for such purposes as pasturing off in the field or for silage.

Varieties for silage.—Tests of corn varieties for silage were begun in 1921. In one field of twenty-four ¼-acre plats three varieties were grown in 1921; in 1922 a fourth variety was added, and the four varieties were grown each year since that time. This field was manured every second year at the rate of about 10 loads per acre. The varieties used and yields obtained during the 4-year test are shown in Table 9.

TABLE 9.—*Acre yields (tons) of silage corn in varietal tests in fields L–I and L–II at the Huntley Field Station from 1921 to 1924, inclusive*

Variety	1921		1922		1923		1924		Average yields	
	Number of plats	Yields	Number of plats	Yields	Number of plats	Yields	Number of plats	Yields	1922, 1923, and 1924	4 years
Calico Dent	8	11.55	6	11.82	6	15.33	6	14.90	14.02	13.40
Mitchell Dent	------	--------	6	11.34	6	14.26	6	14.60	13.40	--------
Payne White Dent	8	9.50	6	11.48	6	13.37	6	13.27	12.71	11.90
Northwestern Dent	8	7.90	6	9.24	6	11.47	6	11.98	10.89	10.15

Of the varieties listed in Table 9, Calico Dent and Mitchell Dent are not so early maturing as the two other varieties, although, during the first three years of this experiment, they were well dented by the average date of harvest, September 12. In 1924, which was a year with an unusually short and cool growing season, these varieties were only slightly past the roasting-ear stage at harvest. The Northwestern Dent variety was fully matured in each of the first three years and in 1924 was sufficiently well matured to make silage of excellent quality. Payne White Dent, though slightly later in maturing than Northwestern Dent, was sufficiently well advanced each year to make silage of good quality and because of its higher yield is to be recommended as a crop for silage. The two later maturing varieties outyielded the others from 1 to 3 tons per acre, but they can not be depended upon to mature each year, and it is desirable to grow, at least in part of the field, some of the earlier corn. It was found that, by mixing the four varieties when filling the silos, a fairly good grade of silage was produced each year.

Another test of corn varieties for silage was made in another field in 1923 and 1924. This test included two early-maturing varieties, Northwestern Dent and Payne White Dent; two late varieties, Wisconsin No. 12 and Silver King; and Minnesota No. 13, a variety maturing in about the same time as Calico and Mitchell.

In 1923 the Northwestern Dent and Payne White Dent varieties were fully matured by the date of harvest; the two late varieties, Silver King and Wisconsin No. 12, were well dented; and Minnesota No. 13 was slightly farther advanced. In 1924, on the harvest date, September 16, the late varieties were barely in the roasting-ear stage, while the early varieties were well past the denting stage and sufficiently matured to make silage of fairly good quality. The yields in this test are given in Table 10. Although the yields of the late varieties of over 16.5 tons per acre were more than 3 tons higher than the smaller earlier maturing varieties, it is doubtful whether this difference in yield is sufficient to make up for the difference in quality and feeding value of the resulting silage, which, for equal weights, is much in favor of the matured corn.

TABLE 10.—*Acre yields (tons) of silage corn in variety tests at the Huntley Field Station in 1923 and 1924*

Variety	1923		1924		Average yields, 2 years
	Number of plats	Yields	Number of plats	Yields	
Wisconsin No. 12	3	16.03	4	17.60	16.81
Silver King	3	16.47	4	16.59	16.53
Minnesota No. 13	3	14.87	4	14.18	14.52
Payne White Dent	4	11.78	4	15.13	13.45
Northwestern Dent	3	12.24	6	13.57	12.90

Seeding rate of silage corn.—A test conducted in 1922 to determine the best rate of seeding for silage corn was repeated in 1924. In this test two rates of seeding were used. In one case the corn was drilled thickly in the row, so that the resulting plants were from 8 to 9 inches apart, and in the second case wider drills were used and the average stand of plants in the row was about 15 inches. The rows in each case were 40 inches apart. Payne White Dent corn, a rather early maturing variety, was used in this experiment.

In 1924 the comparative yields of husked corn in each part of this experiment were also determined.

TABLE 11.—*Stands and yields of silage corn in rate-of-seeding experiments at the Huntley Field Station in 1922 and 1924*

Variety	Stand, distance between plants in row (inches)			Acre yields			
				Silage (tons)			Grain (bushels) 1924
	1922	1924	Average	1922	1924	Average	
Payne White Dent	16.2	14.4	15.3	12.68	13.64	13.16	46.22
	9.3	8.1	8.7	15.00	16.89	15.94	36.55

The yields obtained in both years and other data are given in Table 11. The results in each case are the average of two quarter-acre plats.

The results indicate that in both years the higher yields of silage occurred on the plats with the thicker stand and that this difference was 2.78 tons per acre in the average yield for the two years. The yield of grain in 1924, however, was in favor of the thinner stand, although results are available for only one year and are not to be considered as conclusive.

EXPERIMENTS WITH SUGAR BEETS

Time of seeding.—Experiments in time of seeding sugar beets were conducted in 1923 and 1924. These experiments included in 1923 winter and early spring seeding and in 1924 early and late spring seeding and winter seeding. In including the winter seeding it was thought to increase the length of the comparatively short growing season for beets, especially on the heavier soils, where it is frequently not possible to prepare the land for seeding until the spring is well advanced. All of the land in this experiment was fall plowed, and the preparation of the seed bed for the winter seeding was done immediately after plowing. The date of winter seeding in 1923 was January 8 and, for the 1924 crop, December 27, 1923. The winter-seeded beets germinated early in the spring but made slow growth and reached the thinning stage at about the same time as early spring-seeded beets. The spring seeding in 1923 was on April 11 and in 1924 on April 20 and May 20. Comparatively poor stands of the winter-seeded beets were obtained in both years, owing to greater injury each year by blackroot and in 1924 to frost damage.

The yields obtained in this test are given in Table 12. The yields each year were in favor of early spring seeding. The 2-year average yield of the early spring-seeded beets was 2.34 tons per acre higher than the average yield of the winter-seeded beets. In 1924, beets seeded on April 20 yielded at the rate of 19.55 tons per acre, or 4.43 tons more than beets seeded a month later. Determinations made in 1924 showed the average sugar content of the winter-seeded beets to be 16.6 per cent, of the early spring-seeded beets 17.4 per cent, and of the late spring-seeded beets 14.9 per cent.

TABLE 12.—*Yields of sugar beets in time-of-seeding experiments at the Huntley Field Station in 1923 and 1924*

Time of seeding	Stand, plants per acre		Acre yields (tons)		
	1923	1924	1923	1924	Average
Winter	15,680	16,747	19.54	18.20	18.87
Early spring	22,402	23,040	22.87	19.55	21.21
Late spring	----------	20,688	----------	15.12	----------

The winter-seeded beets each year showed some tendency to set seed.

EXPERIMENTS WITH POTATOES

To determine the value of seed potatoes produced under irrigation as compared with those grown on dry land in maintaining yield, quality, and freedom from disease, an experiment was begun in 1924. Two varieties of potatoes, Triumph and Green Mountain, grown in 1923, both on irrigated and on dry land from seed of the same source, were used in this experiment in 1924. The yields obtained on irrigated land in 1924 are given in Table 13. The yields in each case are the average of two plats.

TABLE 13.—*Yields of potatoes in an irrigated-land and dry-land seed exchange experiment at the Huntley Field Station in 1924*

Variety	Source of seed	Acre yields (bushels)	Percentage of marketable tubers
Triumph	Irrigated land	356.9	88
Do	Dry land	374.6	87
Green Mountain	Irrigated land	356.9	91
Do	Dry land	331.7	86

The results indicate that the yield of the Triumph variety was in favor of the dry-land seed; but of the Green Mountain variety, the higher yield occurred where irrigated-land seed was used. The differences in yield in either case, however, were probably not sufficient to be significant, and since only this one year's results are available it will be necessary to continue this experiment to obtain definite results.

EXPERIMENTS WITH FRUIT TREES

Rather extensive plantings of a large number of varieties of fruit trees, including apples, crab apples, plums, and cherries, have been made at various times since the station was established in 1910. The results of these plantings indicate that it is practicable to grow only the most hardy varieties of these fruits and that the home orchard in this section should be limited principally to hardy plums and crab apples. A few of the more hardy varieties of apples will reach the bearing stage; but the trees are usually short lived, unless grown in some specially protected place.

Varieties of apples that have reached the bearing age are Patten, Northwestern Greening, Hibernal, and Wealthy. Of the crab-apple varieties, the following are recommended: Whitney, Lyman, Hyslop, Peerless, Excelsior, and Florence. Plums that have been found satisfactory are Desoto, Surprise, Wyant, Compass, Terry, Emerald, and Red Wing.

EXPERIMENTS WITH SMALL FRUITS

Several small fruits, including currants, gooseberries, raspberries, and strawberries, have been grown successfully and are desirable additions to the home garden. Varieties of currants that have been tested are Perfection, Cherry, and White Grape; of gooseberries, Houghton and Columbus; and of raspberries, Sunbeam and Ohta. Strawber-

ries are one of the best small fruits for this section, and the varieties most commonly grown are Progressive (everbearing) and Dunlap.

EXPERIMENTS WITH ORNAMENTAL TREES AND SHRUBS

A large number of ornamental trees and shrubs have been tested both on the field-station grounds and on the Huntley project park adjacent to the field station. Hardy trees planted on the grounds in 1912 and in the project park in 1917 reached a height of 15 to 30 feet by 1924. Trees recommended for this purpose are American elm, Chinese elm, green ash, boxelder, native cottonwood, Northwest poplar, Russian-olive, golden willow, and laurel willow. Norway and Carolina poplar have been found to be rather short lived and subject to injury from various insects and borers.

Of the shrubs tested in these plantings the following have been very satisfactory: Persian lilac, common lilac, Siberian dogwood, yellow flowering currant, common snowball, mockorange, highbush cranberry, and Tartarian honeysuckle. Most of the spireas are only semihardy and sometimes suffer winter injury, although some of these, including bridalwreath (*Spiraea prunifolia*) and *Spirea opulifolia*, have been found fairly satisfactory.

For hedge planting, Russian-olive is probably one of the most rapid growing, although Caragana and buckthorn, while slower growing, are to be preferred.

DRY-LAND EXPERIMENTS [3]

This work, which is under the supervision of the Office of Dry-Land Agriculture Investigations, United States Department of Agriculture, was begun in 1912 and deals chiefly with a study of crop rotation and cultural methods, nonirrigated pastures for hogs, crop varieties, and the behavior of soil moisture in its relation to crop production. Other offices of the Department of Agriculture, together with the Montana Agricultural Experiment Station, are interested cooperatively in these investigations.

The experiments were conducted during 1924 in practically the same manner as formerly, and the results are comparable to those previously obtained. The growing season was particularly favorable for the production of small grains, but was somewhat too short and cool for the best results with corn, although early-maturing varieties and strains of that crop made fair yields of grain and stover.

The precipitation from April to August, inclusive, was below the average; but its very favorable distribution, aided by an abundance of water in the soil in the spring, permitted most crops to mature without serious injury by drought. The quality of the crops was high, and the yields generally were above the averages of previous years.

CROP RETURNS FROM ROTATION AND TILLAGE EXPERIMENTS

The results obtained from this line of investigation are presented by crops in the following brief discussions.

Winter wheat.—The Kharkof variety of winter wheat has been used in these experiments since they were begun. Because of the

[3] This report was prepared by Arthur E. Seamans, associate agronomist, who had charge of the dry-land work of the station, being detailed by the Office of Dry-Land Agriculture Investigations of the Bureau of Plant Industry.

generally sufficient moisture supply in 1924, the spread between the average yields of winter wheat from the various methods of production was less than usual. The several methods maintained about the average rank with one another. Summer fallow returned the highest average yield of the season, with 32.6 bushels of winter wheat to the acre. The average yield of winter wheat on disked corn stubble was 31.4 bushels per acre, or but 1.2 bushels less than the average from summer fallow. The lowest average yield was 22.9 bushels per acre, from winter wheat grown on disked wheat stubble. This was, however, only 0.3 bushel less than the average yield of winter wheat grown on plowed wheat stubble. The comparative yields in 1924 from winter wheat on disked wheat stubble and on plowed wheat stubble agree with the 8-year averages for these methods and further emphasize the fact that, where wheat is to follow itself on the same land, it usually does not pay to plow for the second wheat crop.

Table 14 presents the average yields of winter wheat in 1924 and also the average yields for the period from 1913 to 1924, inclusive.

TABLE 14.—*Yields of winter wheat from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields (bushels)	
			1924	1913 to 1924
Fall plowed	Winter wheat	[1] 4	23.2	13.6
Subsoiled	do	1	26.0	14.4
Listed	do	1	24.2	14.3
Disked grain stubble	do	[2] 5	22.9	12.9
Disked corn stubble	Corn	4	31.4	21.6
Fallow	Fallow	[3] 10	32.6	29.3
Green manured	Winter rye	2	29.1	21.9
Do	Peas	2	28.8	26.1
Average of yearly average yields		29	[4] 28.4	[5] 23.0

[1] Two plats previous to 1917.
[2] Begun in 1917.
[3] Three plats 1913 and 1914; nine plats 1915 and 1916; ten plats since 1916.
[4] Average of 29 winter-wheat plats.
[5] Because the number of plats was not the same each year, the figure given is the average of the average yields obtained each year and not the average of the average yields shown for each method.

Spring wheat.—Kubanka spring wheat used in these experiments returned relatively high yields from all methods of production during the past season. (Fig. 6.) The average yield in 1924 of spring wheat on disked wheat stubble, normally a low-production treatment, was 33.8 bushels per acre, the highest of all methods. Spring wheat on disked cornland averaged 29.2 bushels per acre, which was 0.9 bushel more than the yield on fallow. The lowest yield, 19.5 bushels per acre, was obtained from wheat grown on fall-plowed cornland. The results of this year's work indicate that, when moisture conditions are favorable throughout the season, tillage treatments previous to seeding do not greatly influence the yields of grain. The average yields of spring wheat from the various methods of production in 1924 and for the period from 1913 to 1924, inclusive, are shown in Table 15.

TABLE 15.—*Yields of spring wheat from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields (bushels)	
			1924	1913 to 1924
Fall plowed	Corn	1	19.5	15.6
Do	Oats	2	32.2	15.7
Do	Wheat	[1] 3	24.1	12.8
Spring plowed	Corn	1	26.8	16.2
Do	Oats	1	23.8	12.8
Do	Wheat	1	26.7	11.6
Do	Flax	[2] 1	25.2	14.6
Subsoiled	Wheat	1	23.3	12.0
Listed	do	1	30.8	14.4
Disked grain stubble	do	[3] 4	33.8	12.0
Disked corn stubble	Corn	[4] 12	29.2	17.1
Fallow	Fallow	[5] 10	28.3	21.2
Green manured	Winter rye	1	24.3	19.1
Do	Peas	1	27.3	21.1
Do	Sweetclover	[2] 1	29.2	17.4
Average of yearly average yields		41	[6] 28.3	[7] 17.2

[1] One plat previous to 1917.
[2] Begun in 1915.
[3] Begun in 1917.
[4] Eight plats 1913 and 1914, 12 plats since 1914.
[5] Three plats 1913 and 1914, nine plats 1915 and 1916, ten plats since 1916.
[6] Average of 41 plats.
[7] Because the number of plats was not the same every year, the figure given is the average of the average yields obtained each year and not the average of the average yields shown for each method.

FIG. 6.—Dry-land spring wheat and corn in rotation No. 19 (fallow, oats, corn, and spring wheat on disked cornland). In 1924 the acre yields from this rotation were as follows: Oats, 64.1 bushels; corn, 48 bushels of grain and 3,640 pounds of stover; spring wheat, 30.5 bushels

Oats.—The season of 1924 was the most favorable to the production of oats of good quality that has been experienced for several years. (Fig. 7.) An average yield of 55 bushels per acre was obtained on 35 plats of Sixty-Day oats. As was the case with spring wheat, the yields of oats from the various treatments in many cases did not conform to the 12-year average rank of the same methods. Summer fallow and green-manure treatments, usually productive of the maximum oat yields, returned high yields in 1924, but were equaled or surpassed by some of the other methods. The average yield of

oats on disked cornland was outranked by that of several other treatments in 1924, but its relation to the average yield from all methods was about normal. The minimum yield of the various treatments for the season was 36.3 bushels per acre from oats continuously cropped on land fall plowed and subsoiled. This practice has also produced the lowest average yields during the period from 1913 to 1924, inclusive.

Table 16 presents the yields of oats in 1924 and the average yields for the 12-year period.

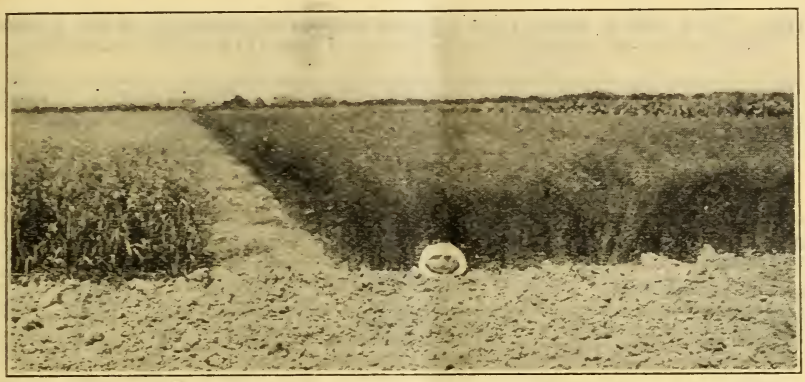

FIG. 7.—Dry-land oats (spring plowed) and flax (spring plowed) in rotation No. 248. The acre yields of this rotation in 1924 were 60.9 bushels of oats and 16.3 bushels of flax

TABLE 16.—*Yields of oats from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields (bushels)	
			1924	1913 to 1924
Fall plowed	Wheat	[1] 6	59.4	34.9
Do	Barley	1	67.2	34.9
Do	Oats	1	40.6	27.6
Spring plowed	Corn	2	42.8	36.3
Do	Wheat	[2] 2	61.3	33.0
Do	Oats	1	56.6	28.1
Do	Flax	[3] 1	60.9	29.4
Subsoiled	Oats	1	36.3	25.7
Listed	do	1	56.3	33.2
Disked corn stubble	Corn	[4] 9	54.2	37.6
Fallow	Fallow	3	61.3	49.1
Green manured	Winter rye	2	59.7	42.6
Do	Peas	2	54.1	44.9
Do	Sweetclover	[3] 1	56.3	39.9
Sod crops	Alfalfa	1	43.8	29.9
Do	Bromegrass	1	42.8	31.0
Average of yearly average yields		35	[5] 55.0	[6] 37.0

[1] Four plats previous to 1915.
[2] One plat previous to 1915.
[3] Begun in 1915.
[4] Eight plats previous to 1915.
[5] Average of 35 plats.
[6] Because the number of plats was not the same every year, the figure given is the average of the yearly average yields and not the average of the average yields shown for each method.

Barley.—The cool weather during the spring and early summer induced a heavy growth of straw and retarded the development of heads until the latter part of July, when hot weather and the near exhaustion of the soil water forced the crop to mature quickly and resulted in poorly filled grain. This condition was exaggerated in the plat of barley on summer fallow. The growth on this plat was so heavy that the crop was seriously lodged, but the yield of grain was only 16.7 bushels per acre, the lowest return of any method for 1924 and less than the 12-year average for barley following this treatment. The average yields of barley are shown in Table 17.

TABLE 17.—*Yields of barley from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields (bushels)	
			1924	1913 to 1924
Fall plowed	Barley	[1] 1	17.3	11.7
Spring plowed	Oats	1	33.5	17.7
Do	Barley	[1] 1	29.6	14.7
Disked flax stubble	Flax	[1] 1	39.6	18.9
Disked corn stubble	Corn	4	29.1	21.2
Fallow	Fallow	[1] 1	16.7	20.7
Green manured	Winter rye	1	25.8	25.3
Do	Peas	1	21.7	26.3
Average of yearly average yields		11	[2] 27.3	[3] 21.4

[1] Begun in 1915.
[2] Average of 11 plats.
[3] Because the number of plats was not the same every year, the figure given is the average of the yearly average yields and not the average of the yields shown for each method.

Flax.—The differences in stand rather than in moisture conditions were almost directly accountable for the differences in the yields of flax in 1924. Germination and growth were very irregular on most plats, but the crop on fallow and fall-cultivated land appeared to be particularly affected. Thin stands and slow growth allowed weeds to gain a foothold, with the result that the yields were reduced according to the amount of weed infestation. The minimum yields were obtained in most cases from land continuously cropped to flax following such treatments as fall plowing, fall subsoiling, and fall listing.

Table 18 presents the average yields obtained from the various methods in 1924 and for the period from 1913 to 1924, inclusive (fig. 7).

Corn.—Although the frost-free period in 1924 was 17 days shorter than the average and the date of the first frost in the fall was 9 days earlier than the average, Northwestern Dent corn, used in these experiments, matured sufficiently to be little damaged by the early freeze. Little difference was obtained between the average grain yields of corn produced by various treatments. Stover yields, on the other hand, varied widely. Yields of ear corn in 1924 were above the 12-year average for every method, but in two instances the yields of stover were less than that average. In general, corn following small grains gave a higher yield by all methods of production than did corn after corn or after summer fallow.

TABLE 18.—*Yields of flax from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields (bushels)	
			1924	1913 to 1924
Fall plowed	Corn	[1] 1	23.2	8.7
Do	Flax	[2] 3	7.0	6.9
Spring plowed	Oats	[1] 1	16.3	7.2
Do	Wheat	[1] 1	20.4	9.0
Do	Corn	[1] 2	16.5	8.9
Do	Flax	[2] 2	14.1	7.3
Subsoiled	do	1	5.0	5.6
Listed	do	1	4.5	6.1
Disked corn	Corn	[1] 2	16.2	8.3
Fallow	Fallow	[2] 2	14.1	10.5
Average of yearly averages		16	[3] 13.3	[4] 8.0

[1] Begun in 1915.
[2] One plat previous to 1915.
[3] Average of 16 plats.
[4] Because the number of plats was not the same every year, the figure given is the average of the yearly averages and not the average of the average yields shown for each method.

The average yields of grain and stover from the various methods of production in 1924 and for the period from 1913 to 1924, inclusive, are shown in Table 19.

TABLE 19.—*Yields of corn from different methods of production at the Huntley Field Station in 1924 and during the period from 1913 to 1924, inclusive*

Seed-bed preparation	Preceding crop	Number of plats averaged each year	Average acre yields			
			1924		1913 to 1924	
			Grain	Stover	Grain	Stover
			Bushels	*Pounds*	*Bushels*	*Pounds*
Fall plowed	Oats	4	36.8	2,678	19.1	1,764
Do	Spring wheat	2	37.1	1,980	19.9	1,702
Do	Flax	[1] 1	31.9	3,300	18.7	2,549
Do	Winter wheat	[1] 1	33.3	3,000	28.9	2,869
Do	Corn	1	28.3	2,660	17.8	1,792
Spring plowed	Spring wheat	[2] 5	37.5	3,040	20.8	1,777
Do	Oats	[3] 13	37.7	2,965	21.0	1,927
Do	Winter wheat	[4] 6	34.2	2,175	19.5	1,721
Do	Barley	3	36.3	2,687	20.8	1,692
Do	Flax	[1] 3	38.1	3,553	19.9	2,172
Do	Corn	1	33.6	1,880	19.1	1,613
Subsoiled	do	1	25.4	2,570	18.2	2,040
Listed	do	1	33.5	1,390	26.6	1,539
Fallow	Fallow	1	33.9	2,360	30.6	2,524
Average of yearly averages		43	[5] 36.0	[5] 2,729	[6] 20.9	[6] 1,882

[1] Begun in 1915.
[2] Four plats previous to 1915.
[3] Nine plats previous to 1915.
[4] Begun in 1914.
[5] Average of 43 plats.
[6] Because the number of plats was not the same every year, the figure given is the average of the yearly average yields and not the average of the average yields shown for each method.

EXPERIMENTS IN PASTURING DRY-LAND CROPS WITH HOGS

The object of these investigations is to determine the possibilities of using various dry-land grain and forage crops as pastures for hogs. In this connection the crops are studied from the standpoint of their

production of palatable and nutritious forage and their ability to supply, either by themselves or in connection with other crops, continuous grazing throughout the summer.

Other information obtainable from these experiments includes the dates between which each of the crops is available for grazing, the carrying capacity of an acre of each crop, the agronomic effect on succeeding crops of the manure resulting from pasturing, and the economic merits of pasturing as compared with harvesting the crops by machinery.

Among the annual crops used in this experiment are winter rye, peas, barley, and corn grown in duplicate 4-year rotations. In one of the rotations all the crops are harvested by machinery, and in the other all except the barley are pastured. The barley plat in the pastured rotation is harvested and the yields of barley in the pastured and the unpastured rotations are compared to determine the influence of pasturing on the production of grain.

In 1924 spring pigs were used in the pasture rotation. Two mature sows with their litters of spring pigs, 17 in number, were placed on the acre of winter rye on May 16. While on pasture, the spring pigs had access to shelled corn in a self-feeder, and the sows were hand fed daily a corn ration approximating 2 per cent of their weight. The pigs were weaned and the sows removed June 27. The pigs remained on the winter rye until July 11, a period of 56 days. The results obtained from pasturing the acre of rye are shown in Table 20.

Throughout the experiment the behavior of the pigs on the rye pasture was compared with that of a similar lot of spring pigs and sows receiving a ration of skim milk and self-fed corn in a dry lot without pasture.

TABLE 20.—*Results obtained at the Huntley Field Station from pasturing various dry-land crops with spring pigs in 1924*

Items of comparison	Winter rye	Check lot for rye	Peas	Check lot for peas	Sudan grass and soybeans	Corn
Area of plat ... acres	1	Pen.	1	Pen.	½	1
Test began	May 16	May 16	July 11	July 16	Aug. 18	Sept. 13
Test closed	July 11	July 11	Aug. 18	Aug. 27	Sept. 13	Oct. 24
Length of test ... days	56	56	38	42	26	41
Number of spring pigs	17	[1] 22	[2] 17	8	[3] 14	7
Average weight of pigs:						
Initial ... pounds	11.3	5.8	32.7	45.4	57.0	86.0
Final ... do	32.7	33.9	55.1	63.6	[4] 86.0	131.3
Gain ... do	21.4	28.1	22.4	18.2	[4] 27.0	45.3
Daily gain ... do	.38	.50	[5] .63	.43	1.04	1.10
Total gain ... do	363	619	381	146	[4] 191	317
Weight of two sows:						
Initial ... do	655	761				
Final ... do	585	647				
Loss ... do	70	114				
Net gain of the lot [6] ... do	293	505	381	146		
Feed consumed:						
Corn ... do	1,300	1,725	740	680		
Skim milk ... do		3,050				
Tankage ... do				120		
Feed per 100 pounds of gain [7] ... do	444	493	194	548		
Corn replaced per acre of pasture ... pounds	144		1,349			
Yield of check plat ... bushels	28.4		21.8			23.4

[1] The lot contained 23 pigs at first, but 1 died soon after the experiment started.
[2] Three pigs were removed at the end of 19 days.
[3] Seven out of 14 pigs died of cholera while on this test.
[4] Based on 7 surviving pigs.
[5] Average of the average daily gains of 3 pigs for 19 days and 14 pigs for 38 days.
[6] Gain of spring pigs minus loss of sows.
[7] Four pounds of skim milk equal 1 pound of corn.

Following the pasture season on winter rye, the 17 spring pigs were moved to an acre of field peas, which carried them until August 18, a period of 38 days. The pigs continued to receive a self-fed ration of corn. Eight similar pigs on self-fed corn and tankage in a dry pen without pasture served as a check lot to the pigs on pasture. The check lot was carried for a period of 42 days. The results of this test are also shown in Table 20.

During the period between the close of the pasture season on peas and the time the acre of corn was ready for harvesting, half an acre of Sudan grass and soybeans was grazed off by 14 of the spring pigs. During this experiment 7 of the pigs died of cholera and the rest were sick part of the time. Notwithstanding this setback, however, the 7 surviving pigs made an average daily gain of 1.04 pounds each during the 26 days on Sudan grass and soybeans with self-fed corn as a supplement. No check lot was used in connection with this test.

On September 13 the 7 spring pigs were moved from the Sudan grass–soybean pasture to the acre plat of Northwestern Dent corn in the pasture rotation. Table 20, previously referred to, gives the results of the season's pasturing with spring pigs.

In addition to the experiments in pasturing annual dry-land crops with hogs, investigations in the pasturing of alfalfa and bromegrass have been conducted. These crops have been grown by two methods, sown in close drills and in rows 2 feet apart. The plats used in 1924 were half an acre in size. The grazing was done by fall pigs. While on pasture, they were fed a daily ration of shelled corn amounting to 3 per cent of their live weight. A check lot of similar pigs was maintained in a dry pen without pasture on a ration of skim milk and self-fed corn.

Table 21 gives the results obtained from pasturing alfalfa and bromegrass, as compared with the returns from growing similar pigs without pasture.

TABLE 21.—*Results obtained at the Huntley Field Station from pasturing alfalfa and bromegrass with fall pigs in 1924*

Items of comparison	Alfalfa		Bromegrass		Check lot
	Rows	Broadcast	Rows	Broadcast	
Area of plat ... acres	½	½	½	½	Dry pen.
Test began	May 16	May 16	May 16	May 16	May 16
Test closed	July 11	July 11	July 11	July 11	June 27
Length of test ... days	56	56	56	56	42
Number of hogs	3	3	2	2	10
Total weight:					
Initial ... pounds	336	321	183	188	1,169
Final ... do	556	558	297	305	2,030
Gain ... do	220	237	114	117	861
Average weight:					
Initial ... do	112.0	107.0	91.5	94.0	116.9
Final ... do	185.3	186.0	148.5	152.5	203.0
Gain ... do	73.3	79.0	57.0	58.5	86.1
Daily gain ... do	1.31	1.41	1.02	1.04	2.05
Ration fed	(1)	(1)	(1)	(1)	(2)
Corn fed ... pounds	724	724	369	369	3,200
Skim milk ... do	.....	.....	.....	.....	2,180
Feed per 100 pounds of gain[3] ... do	329	305	324	315	475
Grain replaced per acre of pasture ... do	466	616	253	281	.....

[1] 3 per cent corn.
[2] Corn self-fed; milk hand fed.
[3] 4 pounds of milk equal 1 pound of grain.

VARIETAL TEST WITH POTATOES ON DRY LAND

Twenty-five selections and varieties of potatoes have been grown in varietal tests on dry land at this station for varying periods of time beginning in 1915. The number of varieties under test has not been the same every year but has ranged from 7 to 15, with an average of 10 each year for 10 years. Two varieties, Irish Cobbler and Triumph, have been grown every year, and several others lack but a year or two of having a continuous record. Many varieties were discarded because of inadaptability; loss of seed through drought, disease, or accident, or because of poor quality.

Table 22 gives the results obtained with six of the more common varieties of potatoes with fairly continuous records beginning in 1915.

FIG. 8.—Dry-land corn in the varietal test conducted in 1923. This corn was planted somewhat later than that in the other experiments and did not suffer so severely from drought

TABLE 22.—*Yields of marketable potatoes of six varieties grown at the Huntley Field Station during the 10 years from 1915 to 1924, inclusive*

Variety	Acre yields (bushels)										Average	Years averaged
	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924		
Irish Cobbler	220.0	93.5	74.3	100.8	(1)	165	50	179.7	93.8	80.7	105.8	10
Triumph	73.3	41.3	40.4	103.3	(1)	90	50	72.4	71.2	107.2	64.9	10
Rural New Yorker	276.8	16.5	79.3	144.8	(1)	20	39	(2)	88.9	112.8	86.5	9
Green Mountain	229.1	77.0	110.0	188.8	(1)	159	25	(2)	113.1	104.6	111.8	9
Early Ohio	141.1	25.8	89.9	99.9	(1)	(2)	(2)	135.7	93.2	141.2	90.9	8
Russet Burbank	(2)	(2)	97.2	179.2	(1)	25	32	73.3	100.7	121.2	78.6	8

[1] No yield as a result of drought.
[2] Variety not planted.

VARIETY TEST WITH CORN ON DRY LAND

Since 1915, 18 varieties and strains of corn have been grown for comparison on dry land. Beginning with 1922, however, the test has been conducted only with varieties that have shown promise of

being adaptable to the greatest production of the best quality of grain or forage. Some of these varieties have not always fully matured grain, but in most cases it has been found that the later varieties under trial ripen grain to the point where the crop is very acceptable for silage or for pasturing, even though it may not be mature enough for husking and storing (fig. 8). The results obtained with 10 of the varieties in this test are presented in Table 23.

TABLE 23.—*Yields of corn varieties grown on dry land at the Huntley Field Station during 1922, 1923, and 1924*

Variety	Acre yields (bushels)			
	1922	1923	1924	Average
Northwestern Dent	24.8	18.3	37.8	27.0
Payne White Dent	24.5	28.9	33.7	29.0
Calico Dent	17.2	[1] 45.8	[1] 39.0	34.0
Golden Glow	21.9	[1] 35.8	[1] 35.9	31.2
Mitchell Dent	30.2	[1] 29.2	[1] 34.4	31.3
Minnesota No. 13	18.1	[1] 29.9	[1] 29.4	25.8
Minnesota No. 23	28.7	17.7	34.4	26.9
Falconer	26.5	27.1	25.8	26.5
Rainbow Flint	[1] 14.8	[1] 63.9	[1] 50.5	43.1
Dakota White Flint	22.3	20.1	26.9	23.1

[1] Immature.

VARIETY TEST WITH SPRING WHEAT ON DRY LAND

The yields obtained from four varieties of spring wheat grown on dry land during the three years from 1922 to 1924, inclusive, are shown in Table 24. Other varieties have been grown in this experiment, but they have not yet been under observation long enough for the results to be compared with those from the four.

TABLE 24.—*Yields of four varieties of spring wheat grown on dry land at the Huntley Field Station during 1922, 1923, and 1924*

Variety	Acre yields (bushels)			
	1922	1923	1924	Average
Kubanka	18.6	8.1	27.0	17.9
Acme	22.0	14.5	31.3	22.6
Peliss	23.5	10.3	26.0	19.9
Marquis	28.8	13.1	30.7	24.2

VARIETY TEST WITH FIELD BEANS

During the six years from 1918 to 1923, inclusive, 10 varieties of field beans were compared in a variety test on dry land. Three of the varieties were grown every year and two others for five years. The remaining varieties were tried for shorter periods of time and were discontinued because of disease, inadaptability, or loss of seed, which last circumstance occurred in the case of Pilot Navy, a very promising strain.

Table 25 gives the yields of the five varieties having the most complete records for the period.

TABLE 25.—*Yields of five varieties of field beans grown on dry land at the Huntley Field Station during the years from 1918 to 1923, inclusive*

Variety	Acre yields (pounds)						Average	Years averaged
	1918	1919	1920	1921	1922	1923		
Great Northern	622	(1)	1,584	(1)	1,307	359	645	6
Early Navy	616	(1)	396	(1)	752	284	341	6
Red Kidney	358	(1)	(1)	(1)	396	149	151	6
Pilot Navy	433	(1)	462	(1)	832	(2)	345	5
Brown Swedish	(2)	(1)	(1)	(1)	462	241	141	5

[1] No yields because of drought.
[2] Variety not planted.

WIDTH-OF-ROW TEST WITH FIELD BEANS

The investigations with field beans conducted on dry land at this station beginning in 1918 have included a comparison of the yields obtained from beans planted in rows 24, 30, and 36 inches apart. Early Navy beans were used in this experiment previous to 1924, and the yields from the 30-inch planting were consistently greater than from the 24-inch or 36-inch rows. In 1924 the Great Northern variety, the field bean most widely grown in this locality, was used in this test. The results obtained show a somewhat greater yield for the 36-inch rows than for either of the narrower spacings. The difference between the latter was small. The discrepancy between the results in 1924 and those of former years may be accounted for, in part at least, by the early frost which caught the wider spaced rows with a higher percentage of immature and consequently heavier beans than was found in the 24-inch and 30-inch rows. The 7-years' results of this test are shown in Table 26.

TABLE 26.—*Yields of field beans planted on dry land at the Huntley Field Station in rows spaced at 24, 30, and 36 inches for the seven years from 1918 to 1924, inclusive*

[The failures in 1919 and 1921 were caused by drought]

Distance between rows	Acre yields (pounds)							
	1918	1919	1920	1921	1922	1923	1924	Average
24 inches	762	0	330	0	929	242	1,195	494
30 inches	799	0	396	0	1,043	284	1,185	530
36 inches	576	0	165	0	998	216	1,388	478

CROP-UTILIZATION EXPERIMENTS [4]

PASTURING ALFALFA WITH HOGS

In field K the third-year alfalfa in a 6-year rotation consisting of alfalfa three years, followed by corn, flax, and sugar beets, is pastured with hogs each year, and in field L–IV the third-year alfalfa in a 6-year rotation of corn two years, oats one year, and alfalfa three years is also pastured with hogs. These rotations are known as No. 67 and

[4] This report was prepared by Robert E. Hutton, formerly junior animal husbandman, who had charge of the animal-husbandry work of the station, being detailed by the Division of Animal Husbandry of the Bureau of Animal Industry.

No. 69, respectively. Rotation No. 67 was started in 1914 and No. 69 in 1917. The plats in these rotations are each one-quarter acre in area.

The pasture season is divided into two periods, the spring period from May to July and the summer period from July to October. Fall pigs are used for the spring season and spring pigs for the summer period. The fall pigs placed on the alfalfa in the spring are carried through the winter on a limited ration to a weight ranging from 90 to 125 pounds each at the beginning of the pasture season. The plat of alfalfa to be pastured is divided into two areas, and the pigs are changed from one to the other at frequent intervals to supply them succulent feed at all times and to facilitate irrigation. In addition to the pasture the pigs are fed 2 pounds of corn daily for each 100 pounds of live weight. The lots of pigs are weighed every 14 days, and the daily grain ration is adjusted after each weighing to accord with the increase in weight of the pigs. About the middle of July the fall pigs are removed from the plat and spring pigs put in their place, being managed in the same manner as the fall pigs. Usually five fall pigs are placed on the quarter-acre plats and eight spring pigs on the same plat for the summer period. To date, 19 trials have been made in pasturing pigs on the third-year alfalfa in these two rotations. In 1924, an outbreak of hog cholera while the spring pigs were on alfalfa pasture caused the death of several of these animals, making it necessary to abandon this phase of the pasturing work.

TABLE 27.—*Results of pasturing third-year alfalfa in irrigated rotations with spring and fall pigs receiving a 2 per cent corn ration on pasture at the Huntley Field Station during the period from 1914 to 1924, inclusive*

[Area of plats, one-quarter acre]

Field	Year	Number of pigs		Total days	Total weight (pounds)		Gain in weight (pounds)			Feed per 100 pounds of gain (pounds)	
								Average daily			
		Fall	Spring		Initial	Final	Total	Fall pigs	Spring pigs	Fall pigs	Spring pigs
K	1914	4	9	138	818	1,393	575	0.90	0.42	323	223
K	1915	5	8	150	1,091	1,710	619	.86	.54	414	212
K	1916	5	8	145	880	1,638	758	1.07	.63	260	197
K	1917	5	8	152	822	1,442	620	1.16	.33	281	293
L	1917	5	9	150	820	1,365	545	1.01	.43	281	258
K	1918	5	8	148	804	1,366	562	.88	.44	309	236
L	1918	5	8	148	800	1,390	590	.85	.42	323	248
K	1919	5	8	159	930	1,549	619	1.01	.39	306	292
L	1919	5	8	161	925	1,449	524	.89	.31	344	343
K	1920	5	8	134	703	1,188	485	.78	.43	237	273
L	1920	5	8	134	693	1,138	445	.78	.40	224	321
K	1921	4	8	124	965	1,466	501	.93	.52	343	270
L	1921	4	8	125	967	1,470	503	.87	.55	366	221
K	1922	5	8	131	913	1,504	591	.86	.59	351	206
L	1922	5	8	131	923	1,522	599	.91	.57	335	215
K	1923	5	8	119	1,070	1,698	628	1.14	.59	281	256
L	1923	5	8	128	1,040	1,635	595	1.15	.46	286	327
K	1924	5	(1)	70	590	885	295	.84	(1)	355	(1)
L	1924	5	(1)	70	584	865	281	.81	(1)	364	(1)
Average				133	860	1,404	544	.93	.47	315	[2] 258

[1] Because of an outbreak of hog cholera, no data are available for the spring pigs on alfalfa pasture.
[2] Average feed required to produce 100 pounds gain in weight, spring and summer periods combined, 281 pounds.

The fall pigs receiving a 2 per cent grain ration on alfalfa pasture have made an average daily gain of 0.93 pound each, and it has required 315 pounds of corn to produce 100 pounds gain in weight. The spring pigs on the alfalfa for the summer period have made lower gains than the fall pigs, but less corn was required to produce 100 pounds gain in weight than with the fall pigs. The average daily gain for the spring pigs was 0.49 pound, and 100 pounds gain in weight was produced for each 258 pounds of corn fed.

Table 27 presents in detail the results of this test during the period from 1914 to 1924, inclusive.

In 1922, 1923, and 1924 check lots of pigs were self-fed in the dry lot for comparison with the pigs on the alfalfa. Three of these check lots were given a self-fed ration of corn and tankage and one self-fed corn and middlings. It has required more than 100 pounds more grain in every case to produce 100 pounds gain in weight in the dry lot than it has with the pigs on pasture. Table 28 presents in detail this phase of the experiment.

TABLE 28.—*Average results obtained at the Huntley Field Station on alfalfa pasture with a 2 per cent corn ration, compared with check lots of pigs self-fed a balanced ration in the dry lot* [1]

[The average number of pounds of grain replaced by 1 acre of alfalfa for the entire season was 3,575 in rotation No. 67 and 3,080 in rotation No. 69]

Items of comparison	Fall pigs used for spring-pasture period (1922, 1923, and 1924)			Spring pigs used for summer-pasture period (1922 and 1923 only)		
	Rotation No.		Dry lot, check	Rotation No.		Dry lot, check
	67	69		67	69	
Average number of days	68	68	57	59	63	63
Average number of hogs	5	5	10	8	8	10
Area of plat ... acre	.25	.25	(2)	.25	.25	(2)
Grain ration	(3)	(3)	(4)	(3)	(3)	(4)
Total weight per lot:						
Initial ... pounds	611	613	1,142	387	354	450
Final ... do	932	934	2,092	646	613	988
Average weight per pig:						
Initial ... do	122.1	122.5	114.2	48.3	44.3	45.0
Final ... do	186.3	186.9	209.2	80.7	76.8	98.8
Average gain:						
Per pig ... do	64.2	64.3	95.0	32.4	32.5	53.8
Daily ... do	.95	.96	1.73	.55	.52	.85
Feed per 100 pounds of gain ... do	329	328	432	229	265	433
Feed replaced per acre of alfalfa ... do	1,323	1,340	----------	2,252	1,740	--------

[1] Three of the check lots of pigs were self-fed corn and tankage and one was self-fed corn and middlings.
[2] Dry lot.
[3] 2 per cent corn.
[4] Self-fed.

HOGGING OFF CORN

The spring pigs used in the alfalfa pasturing experiments in rotation No. 67 are used to hog off a quarter-acre plat of corn in the same rotation, as soon as the summer pasturing period of the alfalfa is completed. The death of several of these animals in 1924 as a result of hog cholera made it necessary to use a wholly new group for pasturing corn. Table 29 gives the results obtained in hogging off corn for the 13 trials conducted since the rotation was started, calculated to an acre basis.

TABLE 29.—*Results of hogging off irrigated corn in rotation No. 67 at the Huntley Field Station, calculated to an acre basis*

Year	Number of hogs	Number of days	Weight of pigs (pounds)			Estimated	
			Initial	Final	Gain	Grain fed per 100 pounds of gain (pounds)	Yield (bushels)
1912	20	16	2,900	3,288	388	530	56.4
1913	16	23	1,312	2,080	768	440	60.0
1914	16	22	1,380	2,276	896	320	50.4
1915	16	25	1,376	2,240	864	450	52.4
1916	16	20	1,516	2,188	672	500	60.0
1917	16	24	1,200	1,828	628	380	43.2
1918	16	27	1,428	2,152	724	510	65.0
1919	16	27	1,636	2,112	476	410	55.0
1920	32	22	2,652	3,444	792	469	66.4
1921	32	18	2,916	3,572	654	609	72.3
1922	32	28	2,452	3,384	932	492	82.0
1923	24	30	2,632	3,560	928	362	60.0
1924	24	21	3,552	4,276	724	520	67.3
Average	21	23.3	2,073	2,800	727	461	60.8

HOGGING OFF CORN AND RAPE

In rotation No. 69, Dwarf Essex rape is drilled between the corn rows at the time of the last cultivation. By the time the corn is mature the rape has made a growth of 10 to 12 inches and furnishes considerable green forage for the pigs. A half-acre plat of corn and rape is hogged off in this rotation each year. Table 30 gives the nine years' results in hogging off corn and rape, calculated to an acre basis.

TABLE 30.—*Results of hogging off corn and rape in rotation No. 69 at the Huntley Field Station, calculated to an acre basis*

Year	Number of pigs	Number of days	Weight of pigs (pounds)			Estimated	
			Initial	Final	Gain	Grain fed per 100 pounds of gain (pounds)	Yield (bushels)
1916	8	38	660	1,246	586	485	50.8
1917	16	22	1,168	1,700	532	433	41.4
1918	16	36	1,156	1,964	808	380	55.0
1919	16	29	1,116	1,930	814	241	66.0
1920	16	36	1,198	2,038	840	392	57.7
1921	16	43	1,474	2,228	754	479	64.5
1922	16	40	1,226	2,068	842	511	76.3
1923	20	30	2,196	3,186	990	339	60.0
1924	20	32	1,641	2,420	779	444	61.7
Average	16	34	1,315	2,087	772	412	59.3

In Table 31 are shown the results obtained from hogging off corn alone, as compared with hogging off corn and rape. It will be seen that the corn and rape have produced pork at the rate of 772 pounds per acre, or 45 pounds more pork per acre than when the corn alone was pastured.

TABLE 31.—*Results of hogging off corn alone and hogging off corn and rape at the Huntley Field Station, calculated to an acre basis*

Items of comparison		Rotation No. 67, corn alone	Rotation No. 69, corn and rape
Number of trials		13	9
Average number of pigs per acre		21	16
Average number of days on test		23.3	34
Total weight per lot:			
Initial	pounds	2,072	1,315
Final	do	2,800	2,087
Total gain per acre of corn	do	727	772
Average weight per pig:			
Initial	do	98.7	82.2
Final	do	133.3	130.4
Average gain	do	34.6	48.2
Daily gain	do	1.48	1.42
Estimated yield of corn per acre	bushels	60.8	59.3
Estimated grain fed per 100 pounds of gain	pounds	461	412

NATIVE-GROWN NORTHWESTERN DENT CORN COMPARED WITH NO. 2 YELLOW DENT CORN GROWN IN THE CORN BELT

A test was begun in 1922 with two lots of fall pigs, comparing the feeding value of native-grown Northwestern Dent with No. 2 Yellow Dent corn grown in the Corn Belt. This work was continued in 1923. The corn was self-fed; in addition, each lot was furnished with a self-fed ration of tankage in 1922 and skim milk in 1923. The average results obtained from the two trials are presented in Table 32.

TABLE 32.—*Average results of two trials of native-grown Northwestern Dent corn compared with No. 2 Yellow Dent as a feed for fall pigs at the Huntley Field Station in 1922 and 1923*

Items of comparison		Variety used	
		Northwestern Dent	Yellow Dent
Average number of days		73	73
Number of hogs:			
At beginning of—			
1922		15	15
1923		15	14
At close of—			
1922		15	15
1923		[1] 14	14
Ration:			
1922		(2)	(2)
1923		(3)	(3)
Total weight:			
Initial	pounds	1,102	1,067
Final	do	2,489	2,515
Total gain	do	1,387	1,448
Average weight per pig:			
Initial	do	73.4	72.8
Final	do	171.8	173.5
Gain	do	96.6	100.7
Daily gain	do	1.34	1.44
Feed consumed:			
Corn, average	do	5,376	5,262
Tankage, 1922	do	300	260
Skim milk, 1923	do	4,610	4,610
Feed per 100 pounds of gain:			
Corn, average	do	387.60	363.30
Tankage, 1922	do	21.63	17.96
Skim milk, 1923	do	332.37	318.34

[1] One pig died. [2] Corn and tankage self-fed. [3] Corn self-fed; skim milk hand fed.

It will be seen that pigs fed No. 2 Yellow Dent corn made slightly faster and more economical gains than those fed the Northwestern Dent corn. Also, it required 28 pounds more of Northwestern Dent to produce 100 pounds of gain than was required with No. 2 Yellow Dent. On this basis, it required 106.69 pounds of Northwestern Dent to equal 100 pounds of No. 2 corn. The Northwestern Dent lot also required 5 pounds more tankage in 1922 and 8 pounds more skim milk in 1923 to produce 100 pounds of gain in weight than did the No. 2 Yellow Dent lot in each case.

FEEDER-PIG PRODUCTION

An experiment in the production of feeder pigs was conducted in 1923. On June 28 a lot of 60 pigs was placed on alfalfa pasture and fed a supplemental ration of 1½ pounds of corn per pig daily. A check lot of 20 pigs with access to corn in a self-feeder at all times was placed on pasture on the same date. The pigs receiving the limited ration were pastured at the rate of about 27 pigs per acre and the self-fed pigs at the rate of 40 pigs per acre of pasture.

At the close of the pasture season 19 pigs from each lot were finished in the dry lot on a self-fed ration of corn and tankage until they reached a marketable weight of 200 pounds each. Forty of the pigs fed a limited corn ration on alfalfa pasture were shipped to Nebraska and sold as feeders at the close of the pasture season.

TABLE 33.—*Limited ration compared with self-fed ration for pigs on alfalfa pasture at the Huntley Field Station* [1]

Items of comparison	Limited ration	Self-fed ration
PASTURE PHASE		
Number of pigs in lot	60	20
Area of pasture ... acres	2¼	½
Number of days on pasture	81	81
Ration on pasture	(2)	(3)
Average weight per pig:		
Initial ... pounds	50.4	51.5
Final ... do	94.1	141.4
Gain ... do	43.7	89.9
Daily gain ... do	.52	1.04
Feed per 100 pounds of gain ... do	288	339
DRY-LOT FINISHING PHASE		
Ration	(4)	(4)
Number of days in dry lot	59	37
Average weight per pig:		
Initial ... pounds	94.1	141.4
Final ... do	204.3	208.9
Gain ... do	110.2	67.5
Daily gain ... do	1.87	1.82
Feed per 100 pounds of gain ... do	428	449
COMBINED DATA FOR TOTAL PERIOD		
Total number of days	140	118
Days to reach 200 pounds	137	113
Average weight per pig:		
Initial ... pounds	50.4	51.5
Final ... do	204.3	208.9
Gain ... do	153.9	157.4
Daily gain ... do	1.09	1.39
Feed per 100 pounds of gain ... do	391	387

[1] One pig died in each lot during the course of the experiment. No adjustments were made for feed consumed or loss in weight from the dead pigs.
[2] 1½ pounds of corn per pig daily.
[3] Corn self-fed.
[4] Corn and tankage self-fed.

While on pasture the self-fed pigs made twice as rapid gains as the pigs fed a limited ration, but they required 51 pounds more grain to produce 100 pounds gain in weight than did the limited-ration pigs. At the close of the pasture season the self-fed pigs weighed 47 pounds more per pig on the average than the limited-ration pigs, so that a shorter dry-lot finishing period was necessary to bring this lot to 200 pounds average weight. For the entire feeding period the advantages of self-feeding on pasture as shown by this trial were as follows: (1) Four pounds less grain was required to bring a pig to 200 pounds by self-feeding the entire period than by feeding a limited ration on pasture; (2) the length of the feeding period necessary to bring the pigs to 200 pounds was 24 days less with the self-fed lot; (3) with irrigated alfalfa pasture charged at $20 per acre the pasture charge per pig was 25 cents less with the self-fed lot than with the limited-ration lot.

Details of the experiment are given in Table 33.

The feeder pigs shipped to Nebraska proved to be the most profitable. This was due in part, however, to an unusual spread in the price of feeder pigs and finished hogs, the latter selling for only 6½ cents, while the feeder pigs sold for more than 9 cents per pound.

The comparisons are shown in Table 34.

TABLE 34.—*Financial comparisons of feeder-pig production at the Huntley Field Station*

[Prices used: Shelled corn per hundredweight, $1.85; tankage per ton, $80; alfalfa pasture per acre, $20. No charge for labor in marketing was made for any of the lots. The labor involved per lot was approximately the same]

Items of comparison	Feeder pigs		
	Shipped to Lincoln, Nebr.	At Huntley, Mont.	
		Finished	Self-fed
Cost of pig at weaning time	$4.00	$4.00	$4.00
Cost of feed and pasture, limited ration	3.05	3.05	
Cost of marketing (freight, $1.06; feed in transit, $0.17)	1.23		
Cost per pig:			
On pasture			5.98
In dry lot			6.13
Cost of finishing in dry lot		9.55	
Total cost per pig	8.28	16.60	16.11
Returns per pig	9.00	13.02	13.32
Profit per pig (marketing charges based on 100 pigs per car)	.72		
Loss per pig (Sold at 6½ cents; 4 pounds shrinkage)		3.58	2.79

FEEDS FOR DAIRY CATTLE [5]

In cooperation with the Bureau of Dairying of the United States Department of Agriculture, a herd of purebred Holstein cattle is maintained at the field station. Experiments in grazing irrigated pasture and in methods of feeding are conducted. The pasturing experiments have included comparative carrying-capacity tests of various grass mixtures and of pastures top-dressed with manure with pastures not top-dressed. Experiments were also conducted to obtain information as to the relative economy of production from

[5] This report was prepared by Thomas W. Moseley, associate dairy husbandman, who was detailed by the Bureau of Dairying to have charge of the work with dairy cattle.

cows fed roughage, a limited grain ration, and a full feed of grain in addition to roughage.

In connection with the breeding project of the Bureau of Dairying it is the plan to use proved sires with this herd for generation after generation. As a part of this project, all purebred bull calves from the station herd are to be proved with regard to their transmitting ability for milk and butterfat producing capacity. To accomplish this the bulls are loaned to local farmers on the Huntley project and in other parts of the Yellowstone and Big Horn Valleys. This phase of the work was begun in 1918, when four of these bulls were placed on near-by farms, and has been increased each year, until at the end of 1924 there were 32 of these bulls in 63 herds with a total of 892 cows. Production records are kept of all the cows in these herds, and cooperating farmers are expected to retain in their possession through at least one lactation period all of the heifers sired by these bulls. In most cases, these herds consist of grade cows, and the results of this work so far indicate generally a marked improvement in the type and production of these heifers over their dams.

PASTURING EXPERIMENTS

Grazing experiments in 1923 and 1924 included a relative carrying-capacity test of pastures top-dressed with manure compared with pastures not top-dressed and a test of the maximum carrying capacity of irrigated pastures. The experiment in top-dressing was begun in 1921 and the maximum carrying-capacity experiment in 1919. The pastures used in the top-dressing experiment were seeded in 1916 in a method-of-seeding test, and three mixtures were used. These mixtures and the rate of seeding are shown in Table 35.

TABLE 35.—*Pasture mixtures and rates of seeding of pastures seeded in 1916 and used in a test of top-dressing with barnyard manure at the Huntley Field Station from 1921 to 1924, inclusive*

Seed used	Rate per acre of seeding (pounds)		
	Mixture No. 1	Mixture No. 2	Mixture No. 3
Awnless bromegrass	2	2	0
Orchard grass	5	5	5
Tall fescue	3	3	3
Perennial ryegrass	3	3	0
Kentucky bluegrass	4	4	4
White clover	2	0	2
Alsike clover	2	0	2
Total seed per acre	21	17	16

These pastures were used from 1918 to 1920, inclusive, in a carrying-capacity test of the three mixtures, when it was found that the average carrying capacity was at the rate of 1.8 cows over a grazing period of 141 days. There was but a slight difference in the carrying capacity of the various mixtures.

From 1921 to 1924, inclusive, these pastures were used in a test of the value of top-dressing with barnyard manure. For the purpose of this experiment the pastures were divided into two pastures of 3 acres

each. Each field was again divided to permit alternate grazing and irrigating.

One of these pastures, designated as pasture A, was top-dressed with manure each fall or winter at the rate of 12 loads per acre, beginning in the fall of 1920. The other, pasture B, was not manured.

During each grazing season the pastures were irrigated at intervals of 10 to 15 days, depending upon conditions of growth and rainfall.

In each year during this experiment the pastures were damaged somewhat by grasshopper invasion. It was possible through the application of control measures to prevent any very serious damage by the grasshoppers, but the yield of the pastures was no doubt decreased to some extent.

The cows used during the course of the experiment were purebred and grade Holsteins, and all were mature animals. Since but a limited number of cows in milk were available, it was necessary during some part of each season to use cows that were dry. All groups of cows were approximately equal in weight, production, and stage of lactation. Cows were added to or removed from each lot at various times during the grazing season, depending upon the condition of growth of the pastures. During the months of June and July, pastures usually produced the maximum growth, and the carrying capacity in these months was higher than it was later in the season.

The cows were fed alfalfa hay on days on which they were off pasture because of stormy weather and were also given a supplemental feed of hay once each day during the last month of each grazing season. This was the only supplemental feed given during the course of the experiment.

The pasture season extended usually from May 15 to September 30, and the variation from these dates was not more than four days during any year of the experiment.

The results obtained during the four years are given in Table 36.

TABLE 36.—*Results of pasturing experiments with dairy cows at the Huntley Field Station, comparing pastures receiving a top-dressing of manure with those receiving no top-dressing*

Items of comparison	Pasture A, manured					Pasture B, not manured				
	1921	1922	1923	1924	Average	1921	1922	1923	1924	Average
Length of grazing season ----------days--	135	136	136	139	136.5	135	136	136	139	136.5
Cows on pasture--------do----	130	117	124	132	125.7	130	117	124	132	125.7
Cows off pasture--------do----	5	19	12	7	10.7	5	19	12	7	10.7
Total cow days per acre-------	147	259	232	251	222.2	131	225	202	189	186.7
Average daily number of cows per acre----------	1.09	1.91	1.70	1.80	1.62	0.97	1.66	1.48	1.36	1.34
Alfalfa hay fed cows:										
While on pasture ----------pounds--	415	462	857	662	599	418	345	706	436	476
While off pasture---do----	176	623	596	355	437	178	519	555	247	375
Average weight:										
Per cow for season--do----	1,149	1,197	1,217	1,306	1,217	1,158	1,269	1,169	1,335	1,232
Gain per cow for season ----------pounds--	65	43	−56	−28	6	68	−71	−90	−27	−30
Gain per acre for season ----------pounds--	71	83	−95	−50	2.2	66	−118	−144	−36	−58
Production per acre:										
Milk----------do----	3,109	4,558	5,356	4,307	4,332	3,528	4,080	3,924	3,451	3,745
Butterfat----------do----	117.5	158.6	200.5	170.7	161.8	122.9	159.2	143.9	115.8	135.4
Skim milk----------do----	2,773	4,105	4,783	3,820	3,870	3,177	3,625	3,512	3,120	3,358

The results indicate that pasture A, manured, had an average carrying capacity of 1.62 cows per acre over an average grazing season of 136½ days, which was an increase of about 20 per cent in carrying capacity over pasture B, not manured, which carried an average of 1.34 cows per acre daily. (Fig. 9.)

The average production of butterfat on pasture A was 161.8 pounds per acre, while on pasture B the production was 135.4 pounds per acre.

On pasture A the quantity of hay fed was 1,036 pounds per acre of pasture and on pasture B 851 pounds. Since this was the only supplemental feed given, the returns after deducting the value of this hay can be credited to the pastures.

On an average, the cows on pasture A maintained their bodily weight about evenly, while the cows on pasture B showed an average loss of 30 pounds.

FIG. 9.—Cows on irrigated pasture at the Huntley Field Station. This pasture had an average carrying capacity of 1.62 cows per acre over an average grazing season of 136½ days during the 4-year period ended in 1924

MAXIMUM CARRYING CAPACITY OF AN ACRE OF IRRIGATED PASTURE

An experiment to determine the maximum carrying capacity of an acre of irrigated pasture was begun in 1919. This pasture was seeded in 1916 to mixture No. 1, described in Table 35, and was top-dressed with manure at the rate of 12 loads per acre each year since 1917. The pasture was divided for alternate irrigation and grazing.

The average length of the grazing season over the 6-year period was 137 days, beginning between May 8 and May 19 and ending about September 30.

Cows of high production were used each year during this experiment. The pasture carried usually two cows during most of each season; and during the months of June and July, when the grasses and clovers made their best growth, one or two additional cows were required to keep the pasture grazed closely enough.

Alfalfa hay was fed on days when the cows were removed from pasture because of stormy weather, and a small quantity was fed each day during the last month of each season.

Table 37 presents the results of this experiment for the six years from 1919 to 1924, inclusive.

TABLE 37.—*Carrying capacity of an acre of irrigated pasture at the Huntley Field Station for the 6-year period from 1919 to 1924, inclusive*

Items of comparison	1919	1920	1921	1922	1923	1924	Average
Length of grazing season ..... days	143	137	135	136	136	139	137
Cows on pasture ..... do	136	134	123	133	131	138	132
Cows off pasture ..... do	7	3	12	3	5	1	5
Total cow days per acre ..... do	283	282	270	290	329	298	292
Average daily number of cows per acre	1.98	2.06	2.00	2.13	2.47	2.16	2.13
Green corn fed cows on pasture ..... pounds	.....	.....	1,850	.....	.....	.....	308
Alfalfa hay fed cows:							
While on pasture ..... do	352	751	952	1,578	1,193	1,013	973
While off pasture ..... do	416	.....	270	228	269	77	210
Grazing period of cows on outside pasture ..... days	.....	3	.....	7	.....	.....	.....
Average weight:							
Per cow for season ..... pounds	1,170	1,117	1,185	1,265	1,124	1,230	1,181
Gain per cow for season ..... do	59	83	90	−20	−9	100	50.5
Gain per acre for season ..... do	118	172	181	−43	−22	216	103.3
Production per acre—							
Milk ..... do	5,992	6,345	8,438	8,225	6,588	9,736	7,554
Butterfat ..... do	199.1	304.7	330.9	307.5	265.1	343.6	291.8
Skim milk ..... do	5,329	5,229	7,493	7,347	5,831	8,755	6,664

The pasture had an average carrying capacity over this period of 2.13 cows per acre. The average production of butterfat each year from this acre of pasture was 291.8 pounds. The hay consumed weighed 1,183 pounds, and in one year a small quantity of green corn was fed. This was the only outside feed given the cows during the pasture season. The cows made an average gain in weight of 103 pounds for the acre of pasture.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

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